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GY. BODROGKÖZY

ADJUVANTIBUS

L. GALLÉ, I. KISS, M. MARIÁN, M. MIKES, L. MÓCZÁR, M. OBRADOVIĆ

REDIGIT

IMRE HORVÁTH

Index

SZEGED 1979

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DISSERTATIONES BIOLOGICAE A COLLEGIO EXPLORATORUM FLUMINIS TISCIAE EDITAE

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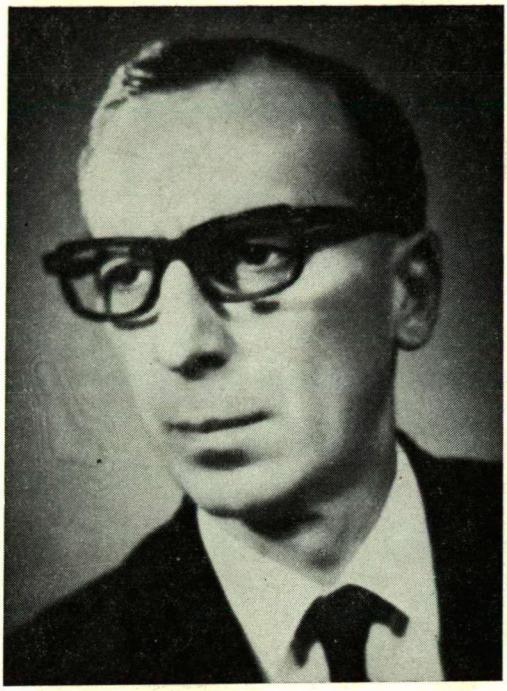

PROFESSOR DR. IMRE HORVÁTH

1926—1979

A startling news had gone round Hungary and, even, a part of the world. The head of the Department of Botany and the Botanical Gardens of the Attila József University, the chairman of the Tisza-Research Executive Committee, the member of the governing bodies of several university-, academic and public organizations, the ardent environment protector and nature preserver deceased after a prolonged illness.

Beyond the circle of this family proper and of his relatives, the loss of Professor HORVÁTH has been mourned the most keenly by those who were his closest collaborators, the more than fifty members of the Tisza Researchers.

Professor Dr. IMRE HORVÁTH was born fifty-three years ago in Hódmezővásárhely, a town situated 25 km from Szeged. There he had completed his primary and secondary studies; then he enrolled himself at the Faculty of Sciences of Szeged University as a student, a future teacher, studying natural history and geography.

His professors soon took notice of his eminence, of the more than ordinary love that he developed for his profession at an early date and of his zeal. Even before taking his degree, he was allowed to start work as an undergraduate research assistant at the Department of Botany, where he joined in the xylotomy researches, in progress there.

His gift for organizing qualified him, after graduation, for the position of secretary at the Biology Section of the Hungarian Academy of Sciences.

Having taken his candidate's degree at the Hungarian Academy of Sciences, he was active as teacher and educator at the Department of Botany of the University

for Agricultural Sciences in Gödöllő. His researches were plant-aut-ecology-oriented. He was the first scientist in Hungary to work out the methodology of the phytotron, and he carried out researches into how to put this into practice.

In 1965, he was appointed head to the Department of Botany and the Botanical Gardens of the Attila József University in Szeged, as the post had fallen vacant by the retirement of the previous chair-holder. On submitting and defending his thesis entitled "The causes of fir samplings' getting bowed" he was awarded a doctor's degree in biological sciences by the Hungarian Academy of Sciences, and he was appointed full university professor.

After coming to Szeged, he took over the chairmanship of the Tisza-Research Working Committee, without head after the death of Professor KOLOSVÁRY. The new chairman, who was remarkably experienced in organizing, worked out a detailed plan for specialists in hydrology, botany, and zoology, in cooperation with the team heads in each special field, and the plan was approved and even backed financially by the Biology Section of the Hungarian Academy of Sciences. He imposed and laid down, both for instruments and for laboratory equipment, the primary conditions of the extended researches launched over a wide range.

Of the members of the Working Committee, several young researchers took positions as teachers of biology, specialists in museum work, hydrologists and microbiologists at water conservancies in the towns along the Tisza. Many of these researchers were given home study grants in order to promote their further professional training. This meant that they were able to enrich their knowledge and experience in various Hungarian institutions under researchers of wide professional experience.

Professor HORVÁTH focussed the researches that took on a complex character upon the most exposed stretches of the river Tisza, important for practical purposes, as well. Therefore, he worked out a detailed plan for a minute investigation into the reaches affected, or to be affected in the near future, of the Tisza II river barrage. While these researches were in progress, the staff of the Tisza II Laboratory also joined the Working Committee.

Another set of research tasks was the detailed and complex survey of the nature reserve area along the Tisza, ranging from the living world of slack-waters to that of the forests. As owing to the advancement of anthropogenic impact and that if the ever intensifying practical activity upon the areas of the Tisza valley, the living world of the river and the surrounding country-side got more and more changed, it became desirable to restore along certain stretches of the river at least a part of the original living world which could be recovered. Professor HORVÁTH became aware of the significance, of the vital importance of this idea both for the present and for the future. As a prerequisite of realizing this end, he set up a work team to make plans. The implementation of the plans broken down by years has already started, and the researches are in progress.

It is owing to Professor HORVÁTH's organizing activity, that on the site which is best for the implementation of the plans to restore living world, on the Körtvélyes island, level with Hódmezővásárhely, a base building for research purposes has been set up.

The plans made by the Tisza-Research Working Committee include, among others, that the area in Csongrád district, which is going to be submerged when the next river barrage opens up, should be investigated in detail. Thus he had another base building constructed there.

In order to help and to facilitate the work of the research team made up of

hydrologists and botanists analysing the water of the river, he made arrangements that two motor boars be bought: one rather large, the other smaller. These conveniences offer opportunities for a complex analysis of the longitudinal section of the river water.

Hungarian and even foreign institutions have taken notice of the activity of the Working Committee headed by Professor HORVÁTH and of the success his work has met with, which can be tested by the matter given as lecture courses at the annually organized Tisza Research Conferences, and can also be evaluated by reading through the papers contributed to the annual publications of Tiscia, having appeared for more than ten years. First, the State University of Novi Sad (Jugoslavia), then the heads and researchers of the biological departments of the State University of Uzhorod (trans-Carpathian territory, USSR) joined in the Tisza research. It was due to Professor HORVÁTH above all that cooperation at international level could be achieved.

The head of the Working Committee in his full prime, able to inspiring his Committee to do valuable work, was carried away by death but every member of his Working Committee wants to follow, with undiminished energy, the course staked out by him, and to implement the long-term plans in the spirit of his intellectual legacy. We shall keep for ever the memory of our beloved chairman.

DR. GYÖRGY BODROGKÖZY

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INVESTIGATION INTO THE WATER QUALITY OF THE TISZA FROM CSONGRÁD TILL TISZASZIGET

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(Received 20 September 1978)

Abstract

It is to be established, on the basis of the systematic investigation of the Lower Tisza Region for ten years that the water of the river has been polluted and deteriorated in its quality. At present, we can only see at classifying the quality of the water that for collective water supply and for fish husbandry it is of second class.

It is shown by our investigations that the solute oxygen content decreases, the amount of organic matter increases in these reaches. From time to time, the oxygen quantity consumed for oxidizing the organic and inorganic compounds is raised by passing down of sewage-waters. The salt content of water increase of sodium content is shown by the results obtained at our sampling site below the inflow of the Maros, at Tiszasziget – the frontier of the country. Nitrates occur in a considerable quantity. The quantity of ammonia is indifferent because the water supply of the population comes in this stretch not from the water of the river. By the richness in nutritive material, in case of slow water flow, an algal-multiplication of large mass is induced as a result of light. The increasing mineral-oil pollution also draws the attention to the protection of the water quality of the river.

Introduction

The river Tisza runs in the deepest part of the Great Hungarian Plain. It collects the most part of waters from the eastern part of the Carpathian basin, its largest tributaries being partly the Szamos, Körös and Maros, partly the Bodrog, the Sajó — increased by the Hernád — and the Zagyva. — The ground of its watershed area, the composition of its base rock and the decaying processes all have a determinative effect upon the composition of the water of the Tisza (LÁSZLÓ 1974). In Fig. 1, the Tisza stretch investigated by us is illustrated, indicating the sampling sites.

It is to be seen that, in these reaches, the waters of the Körös and Maros may extert an effect upon the composition resp. quality of the water. In this part, the water pollution of different origins does not induce any lasting state, resp. definite change in the composition and quality of water.

In 1968–1978, i. e. during a ten years long span of time, we investigated into this river stretch and could, therefore, follow with attention the changes in the composition and quality of water. During this time we could observe that the water of the river becomes more and more polluted. The composition and quality of water are secondarily influenced by this pollution. The pollution is connected with urbanization, agricultural and industrial activity.

It is, of course, natural that the original water composition of the river, named

as primary composition, and also this secondarily developed water composition, are considerably changed by climatic factors, too, namely water output, temperature, and the number of sunny hours, etc. (HORVÁTH 1976).

Survey of methods

In the lower Tisza region (Fig. 1) the composition and quality of water were fortnightly regularly investigated. In the first time, water samples were taken at more sampling points. We were conviced by the analyses that it is enough to take water samples at the five sites marked in the map.

Our sampling sites were the following:

(1) Gauging station at Csongrád	246.0 river-km
(2) Railway-bridge at Szentes (below the mouth of the Körös)	242.0 river-km
(3) Gauging station at Mindszent	216.2 river-km
(4) Pontoon-bridge at Tápé	177.5 river-km
(5) Tiszasziget (frontier of the country)	158.05 river-km

The sampling sites are good characterizers for investigating water composition and quality in these reaches of the river. At these sites, there is no river- or sewageinflow, they are" impulse"-free parts of the river.

For determining water composition and quality, the following methods were used: The quantity of soluble oxygen was determined by manganese hydroxide. The essence of the iodimetric determination of the water-solute oxygen is that in an alkaline solution the manganese (II)-hydroxide oxidizes, under the influence of the solute oxygen, to manganese (III)-hydroxide and this releases, after acidification, from KI pure iodine, equivalent to oxygen, which can then titrated with thiosulphate. The biological oxygen requirement – BOR – was then established on the basis of the decrease of the oxygen content of the original or diluted water sample within a given time. Sodium was examined at 589 nm with flame photometer. The quantity of ammonia was measured at 400 nm on the basis of the reaction of ammoniamercury (II) – iodid complex. This forms with Nessler's reagent, in an alkali medium, a yellowish-brown compound. The colour intensity is proportionate to the quantity of ammonia. Nitrite was also determined on the basis of colour intensity by connecting diazonium with alpha-naphthyl-amine and the reddish violet colour can be measured by a photometer at 520 nm. There was evoked a reaction between nitrate and sodium salicylate in a sulphate medium and the obtained yellow colour was measured at 410 nm with a photometer. The oil content was examined gravimetrically, resp. spectrometrically (ERDEI 1970).

Exposition and discussion of our results

The utilization of the Tisza water is considerably influenced by the deterioration of water. The protection of the water quality of the river in the home stretch and in its whole downflow is fundamentally important. This is, of course, accompained by the requirement of protecting the river-waters getting into the Tisza. Both the organic and the inorganic polluting materials, NH_4^+ and mineral oil, as well, may and do cause many problems because they dissolve difficultly and only in a small degree. These materials prevent the river-water from being used as drinking-water.

The present-day situation of the river reaches investigated is changed by operation the river barrage at Ó-becse. The biological and sedimentary state of this river stretch is changed by the operation of the river barrage.

Nowadays, an essential condition of the management of water supplies is to evaluate and classify water quality. Waters are classified according to their utilization, on the basis of general and special characteristics. Waters are utilized in the following three large groups:

(1) communal, (2) industrial and (3) agricultural water supply. To these three kinds of water utilization, waters are evaluated as belonging into the first and second

classes (I, II). The waters belonging to the first class (I) are clear waters. These waters are suitable to be used for anything, without any particular, special demand. The waters belonging to the second class (II) are a little polluted, are not suitable for cummunal water supply and not always for industrial aims, either.

We have summarized in tabular form the classification of water quality, according to the sampling sites of the river reaches investigated (Table 1).

Table 1. *Classification of the water of the sampling sites*

Utilization:	Water-gauge at Csongrád	Railway-bridge at Szentes	W.-gauge at Mindszent	Ponton-bridge at Tápé	Frontier of the country at Tiszasziget
Communal water-supply	II	II	II	II	II
Industrial water-supply	I	I	I	I	I
Agricultural water-supply					
Irrigation	I	I	I	I	I
Fish-breeding	II	II	II	II	II

The Table is showing the summarizing result of our investigations that, namely, the water of the lower Tisza reaches in uniform from the point of view of its usefulness.

Further on, results obtained are made known in details.

In the Figure transformation of, resp. change in the solute oxygen amount is to be seen the values of the 5-day oxygen requirement shown as a function of time. The plants and animals living in the water — the living world of water — generally breathe from the solute oxygen. The living world of the dry-land can utilize the oxygen of the atmosphere in unlimited quantities — those living in water are, however, in a more special situation. The oxygen content of water becomes partly enriched from the air but partly the oxygen produced in the photosynthetic process of the aquatic vegetation also gets here. Additionally, the quantity of the solute oxygen is diminished by the oxydative process of the organic matters in water. It is shown by the results of our 10-year investigations that the solute oxygen content of the Tisza water is decreasing. The solute oxygen content of the river-water is also influenced by temperature. In Summer, we obtained very low values, measuring 3.5 mg/l and for the winter period even 13 mg/l solute oxygen quantity.

In Fig. 2, the formation of the biological oxygen requirement is also shown. The biological oxygen requirement shows the quantity of the oxygen required for decomposing the organic compounds and the temporal tempo of oxygen consumption, as well. This is named the 5-day biological oxygen requirement. In England, the sewage-waters get to the sea from any place in five days — that is the reason of the designation.

The process of self-purification is aided by microorganisms, as well. For the biological oxygen requirement the quantity of oxygen is calculated as (BOR) mg/l, needed at a duration and temperature for decomposing the organic matters. It is shown by the Figure that the BOR-quantity of the Tisza water increases, its organic-matter loading shows, therefore, an upward tendency.

In Fig. 3, the oxygen quantity consumed at the oxidation of the organic and inorganic compounds in water is shown. The 30–40 mg/l oxygen consumption value recently occurs more frequently. There are obtained higher values when — periodically — a pollution wave passes down the Tisza and the sampling date coincides with this wave. The average values of our monthly two recordings show equalization in a certain meaning.

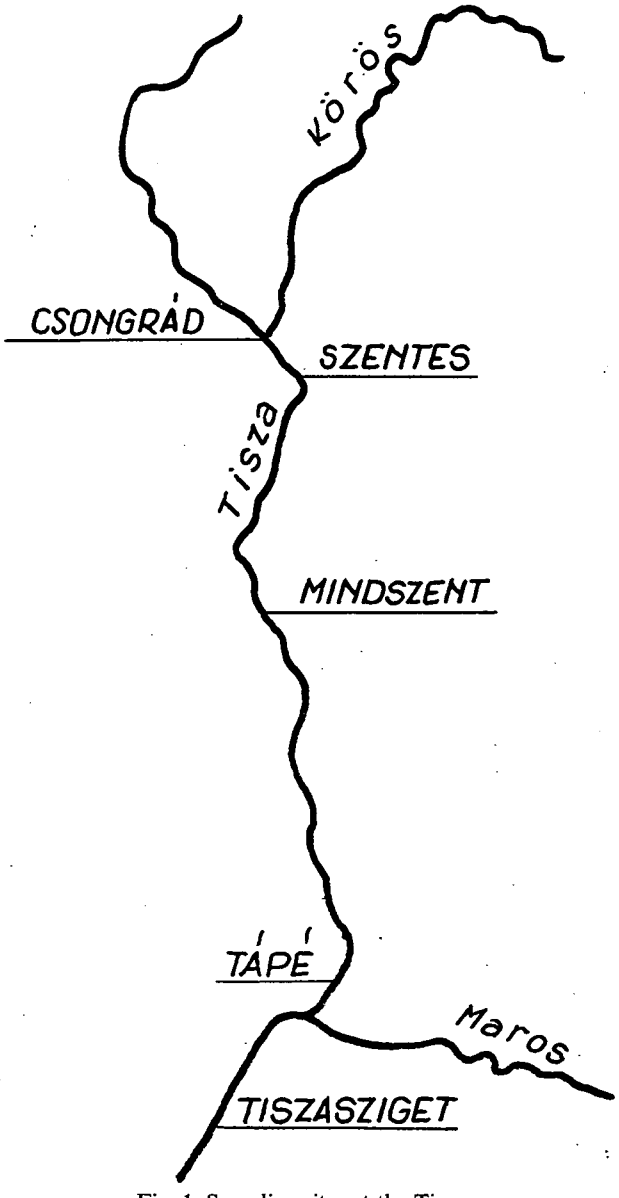

Fig. 1. Sampling sites at the Tisza.

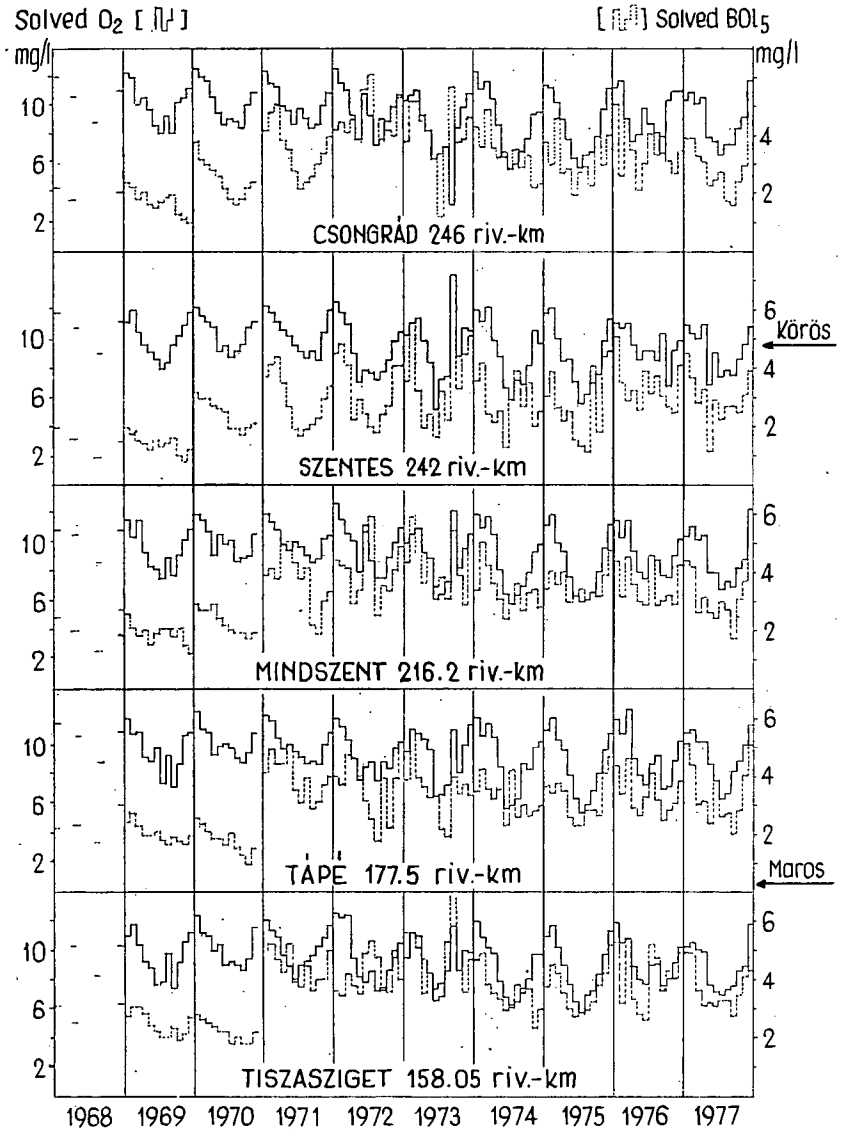

Fig. 2. Formation of solute O_2 and BO/5 in the longitudinal section of the Tisza (1968—1977).
Solute O_2(–) $BO/_5$ (. . .)
mg/l mg/l
fkm=river-km

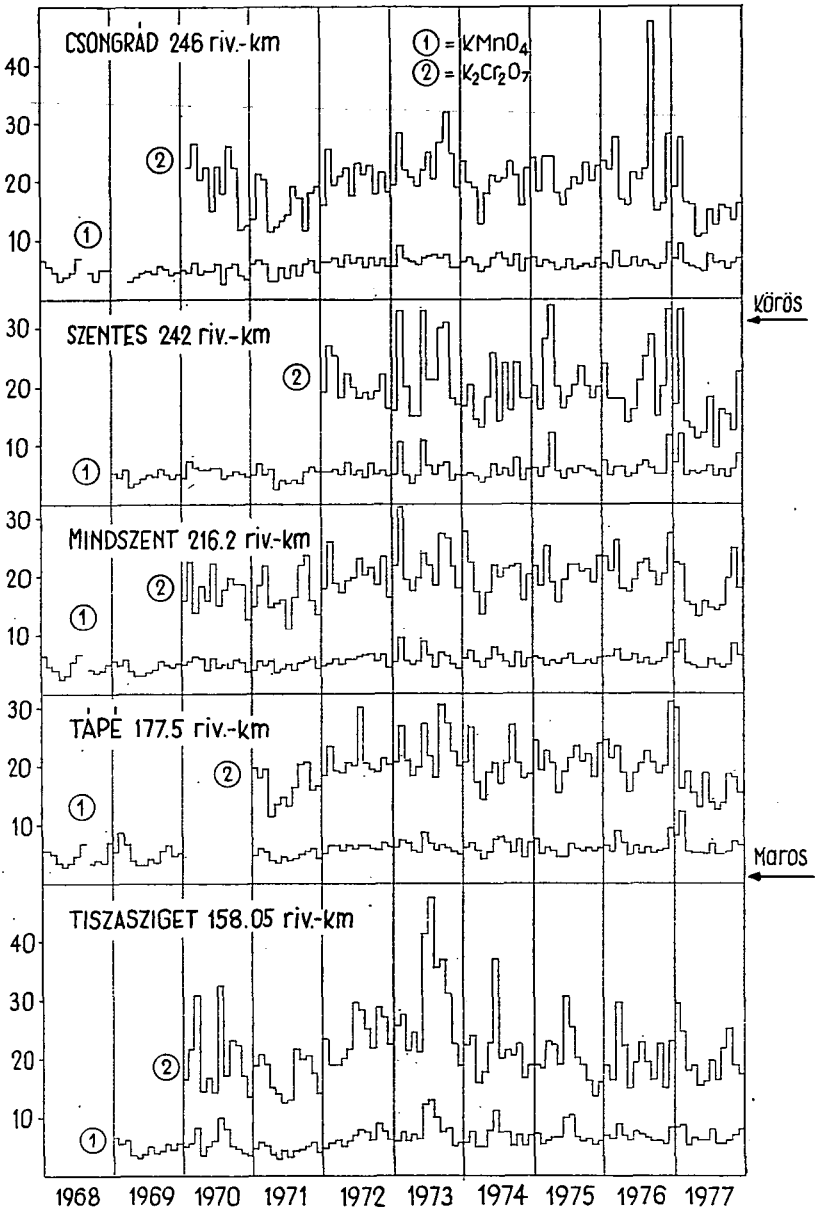

Fig. 3. Formation of the oxygen consumption ($KMnO_4$ and $K_2Cr_2O_7$3 in the longitudinal section of the Tisza (1968–1977).
fkm = river-km

The formation of the solute-matter content of the river water and the percentage of sodium is represented in Figure 4.

Together with the increase in salt content of the river-water, the ratio of alkali decreases. The total solute matter content is determined by the quantity of Ca, Mg, Na, K, CO_3, HCO_3, SO_4, and Cl. The solute salt content is 150–400 mg/l. This is amount and its minor fluctuation (±50 mg/l) is accepted as an average value. The salt content seems to increase a little in the water of the river.

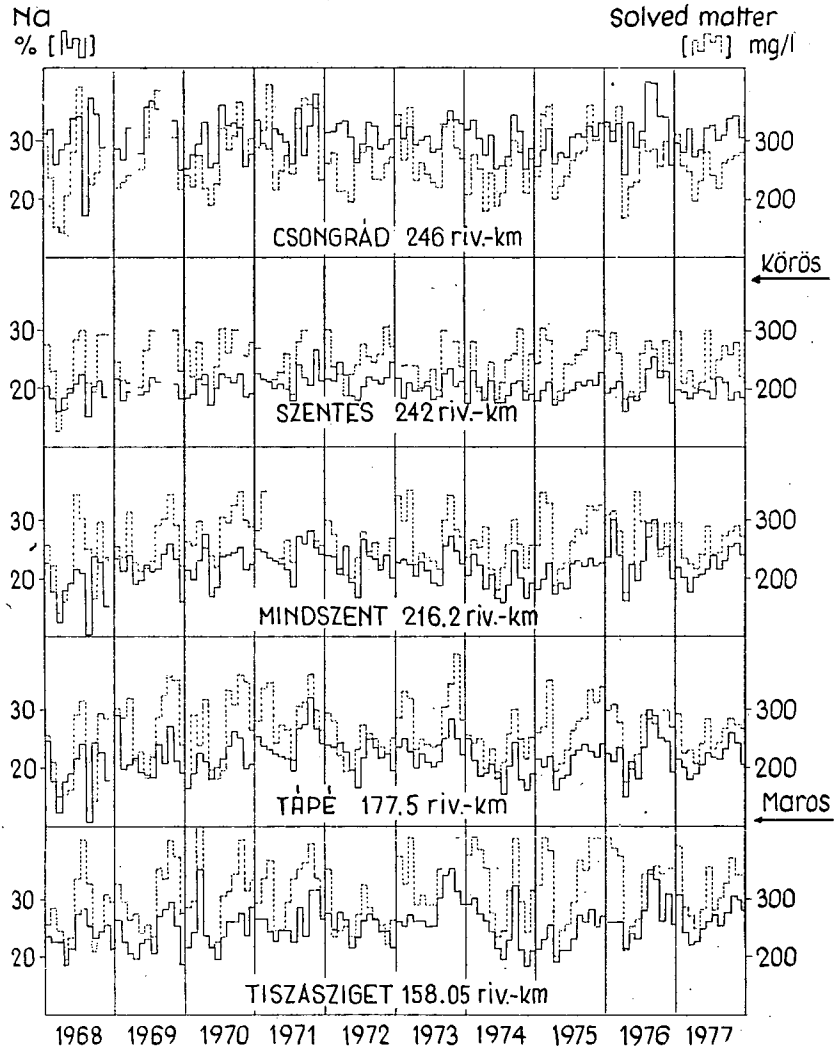

Fig. 4. Formation of the solute matter and Na per cent in the longitudinal section of the Tisza. (1968–1977)
Na p. c. (–) Solute matter (. . .) mg/l
fkm=river-km

At the concentration of sodium ions it was observed that the composition of the Tisza water was influenced by the inflow of the Maros. The sodium content increased both in absolute value and in percentage (Tiszasziget, Frontier of the country). From among the anions chloride ion also occurs. Along the longitudinal section of the Tisza an increase can be observed both in the solute content and in the percentage of sodium.

The change in nitrate and ammonium ions is shown by Fig. 5.

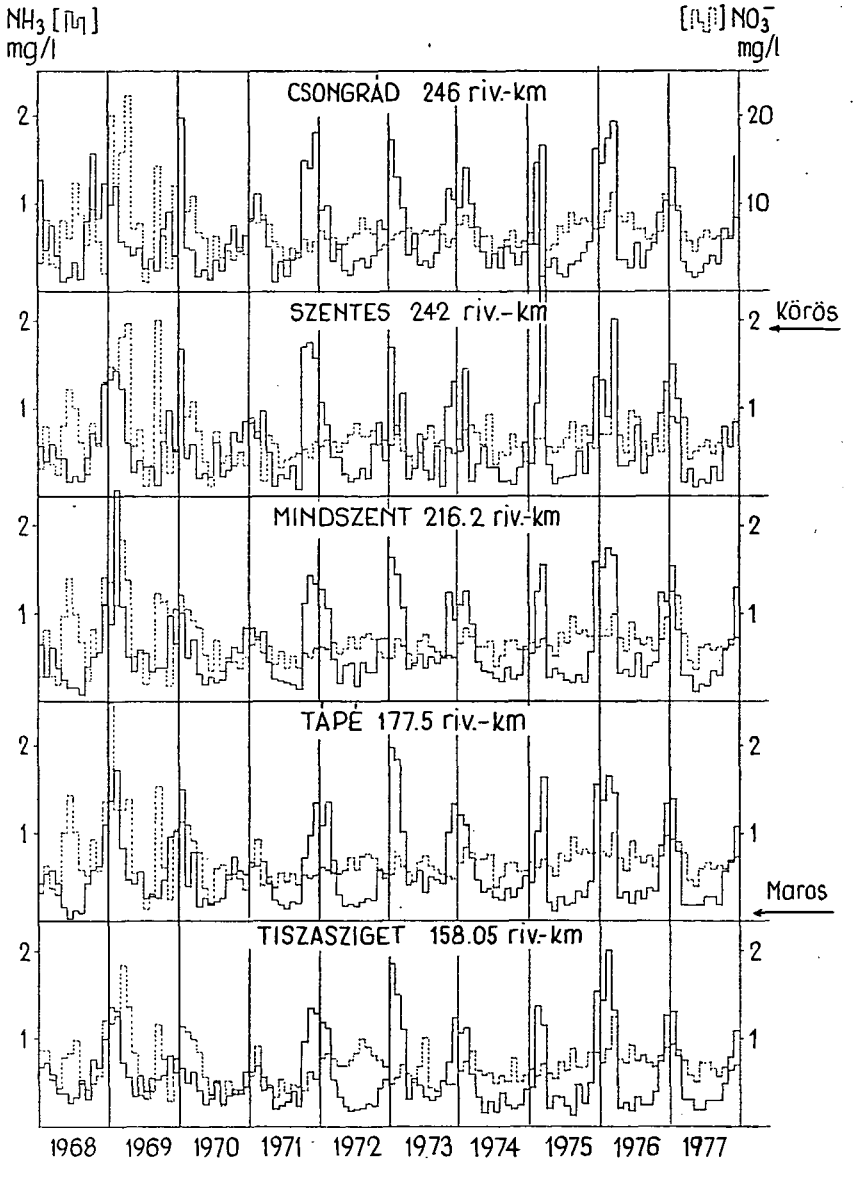

Fig. 5. Formation of NH_3 and NO_3 in the longitudinal section of the Tisza.

The rainwater falling immediately into the river water, averagely contains 0.36 mg/l nitrogen in form of ammonia and nitrate (WURZEL 1975). A considerable part of the nitrogen content of rainwater, and if the precipitation gets immediately into the soil, it is transformed into nitrate by bacteria. Additionally, the subsoil water continues concentrating in nitrate content as the ammonia originating from the plant proteins disintegrating in the soil is transformed into nitrate by bacteria. The subsoil waters give, however, but little nitrogen for the surface. Nitrogen and the phosphoric compounds occur in waters in a very thin concentration. From among the occurences of hydrogen in organic and inorganic compounds nitrates are the most considerable ones. The nitrate content of waters is very low and it changes in annual periodicity, as well. The ammonia content of the water of the Tisza is 1.5–2 mg/l from January till March. This value takes place partly because nitrification is slower at a low temperature, partly because the oxidation of ammonium is pushed into the background by the easily oxidizable organic pollutions of the larger oxygen content. In the stretch investigated — from Csongrád till Tiszasziget — the ammonia quantity is indifferent because the water supply of the population does not originate from the water of the river. It is shown by Figure 5, as well, that the nitrate content in these reaches, increases year by year. The nitrate content is not increased by human settlements or by the sewage-waters of towns but by the large amount of the artificial fertilizers applied in the agricultural and horticultural plant cultivation. The artificial fertilizer gets into the water of the river by running off from land it can at present be said of it that this quantity is not deleterious, as yet. The full operation of the river barragd at Ó-becse may already cause some problems from this point of view. In August 1977, the river barrage still operated only with one sluice. At Szeged, the drift sped of the water of the river was 0.3 m/sec. At such a slow water speed, there can already develop a certain eutrophic state which is rich polluted nutritive matters. The decreased water speed carries but little floating matter. The water-layer is transilluminated by the sunshine well and by the much nutritive matter mass algal multiplication may be brought about.

Of late, from the point of view of water pollution, mineral oil and its derivatives are very considerable. The results of these investigations are to be seen in Fig. 6.

The application of mineral oils and their derivatives has increased very much and these have become permanent polluters of waters. The damaging effect of mineral oils may appear in different ways. Some products have a smell and taste impairing effect even if diluted ten-million times. In a larger amount, they form a membrane on waters and prevent oxygen diffusion and, with that, self-purification. They are harmful in drinking-water even in an amount below the permissible value (threshold value) because they can accumulate in human and animal organisms (toxicity). Of late years, much damage was induced in several places, thus in our country, too, by the pollution of mineral oil and its derivatives. The oil-pipelines, laid down along the rivers, along the Tisza, as well, have already caused considerable pollution. The pollution by water crafts, ships, motor-boats, as well as that originating from motor traffic, public institutions and households are also considerable (Fig. 6). The oil pollution of the Tisza water has yearly intensified by the mineral-oil utilization — water quality is to be protected more and more against this factor, as well.

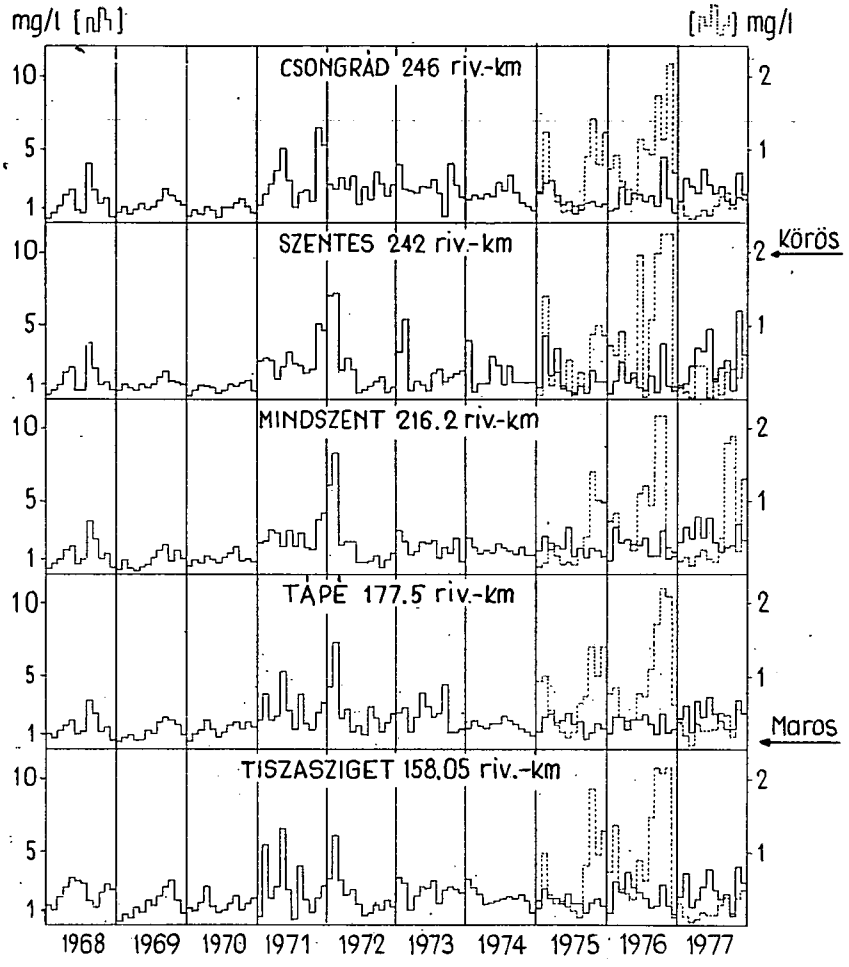

Fig. 6. Formation of the gravimetrically measured and UV oil in the longitudinal section of the Tisza.

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A Tisza vízminőségének vizsgálata Csongrádtól Tiszaszigetig

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Kivonat

Az Alsó-Tisza-szakasz vizének tízéves rendszeres vizsgálata alapján megállapíthattuk, hogy szennyeződik és minőségében romlik a folyó vize. Ma még a víz minőségének az osztályozásánál csak azt látjuk, hogy közületi vízellátásra és halgazdaságnak másodosztályú.

Vizsgálataink mutatják, hogy az oldott oxigén tartalom csökken, a szervesanyag mennyisége gyarapodik ezen a folyószakaszon. Időszakonként a szennyvizek levonulása megemeli a szerves és szervetlen vegyületek oxidációjához elhasználódó oxigén mennyiségét. Növekszik a víz sótartalma, és a Maros beömlése után a Tiszasziget—Országhatár mintavételi helyünkön kapott eredmények a nátrium-tartalom emelkedését mutatják. Jelentős mennyiségben fordulnak elő a nitrátok. Az ammónia mennyisége azért közömbös, mert a lakosság vízellátást ezen a szakaszon nem a folyó vize szolgáltatja. A tápanyaggazdagság lassú vízáramlásnál fény hatására nagy tömegű alga-szaporulatot okoz. A fokozódó ásványolaj-szennyeződés is a folyó vízminőségének a védelmére irányítja a figyelmet.

Istraživanja kvaliteta vode reke Tise od Csongrád-a do Tiszasziget

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Abstract

Na osnovu 10-to godišnjeg ispitivanja donjeg toka Tise utvrdjeno je pogoršavenje kvalivteta i zagad jivanje reke. Pri kategorisanju, voda po kvaliteta i zagadjivanje II razredna i upotrebljiva je za komunalne potrebe i ribnjake.

Naša ispitivanja pokazuju opadanje količine rastvorenog kiseonika i povećavanje količine organskih materija na ovoj deonici. Pri povremenim zagadjenjima oksidacija organskih i neorganskih jedinjenja povećava i količinu kiseonika. Raste i količina soli, i to natrijuma, iza ušća reke Maros. U znatnim količinama se javljaju i nitrati. Amonijak je prisutan u neutralnim količinama, im, u vidu da stanovništvo ne koristi vodu reke. Bogatsvo hranljivih materija pri usporenom vodotoku pod uticajem svetlosti, rezultuje razmnožavanje velike mase algi. U pogledu zaštite kvaliteta vode pažnju treba obratiti i na tendenciju povećavanje zagadjivanja naftom.

Анализ качества воды р. Тиса от Чонграда до Тисасигета

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На основании систематического, проводимого в течение десяти лет анализа качества воды нижнего течения Тисы можно установить, что вода реки всё более загрязняется и качество воды ухудшается. В настоящее время при оценке качества воды установлено лишь то, что с точки зрения общественного водоснабжения и рыбоводческих хозяйств её следует отнести к водам второго класса. Наши исследования показывают, что в этой части реки в воде наблюдается снижение содержания растворимого кислорода и повышение количества содержащихся в ней органических веществ. Периодический сток грязной воды повышает количество кислорода, потребное для оксидации органических и неорганических соединений. Повышается содержание соли в воде, и анализы, образцов взятых после впадения в Тису р. Марош, в районе Тисасигет-Орсагхатар, показывают повышение содержания натрия. В значительном количестве наблюдаются нитраты. Содержание аммиака в этой части реки не имеет значения, так как снабжение населения водой здесь осуществляется не за счёт речной воды. Высокое содержание питательных веществ при медленном течении воды под влиянием света приводит к массовому размножению водорослей. О необходимости принятия мер по охране качества воды свидетельствует и повышающееся загрязнение минеральными маслами.

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WATER INVESTIGATIONS OF THE TRIPLE-KÖRÖS

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Abstract

We have investigated into the quality of water from samples taken at Magyartés and Kunszentmárton. It could be established that the water of the Triple-Körös at the sampling site in the neighbourhood of Magyartés is of first class from any points of view of utilization. The water samples taken at Kunszentmárton, however, showed that the water quality was influenced by the inflowing sewage-water. It is nonetheless obvious on the basis of the seven years long investigation that the Triple-Körös is our clearest river water, its pollution is of very small degree.

*

From the Bihar mountain dividing the Great Hungarian Plain from the Transylvanian Basin, four rivers begin flowing to the West: the fan-like converging Berettyó, the Rapid-, Black- and White Köröses. The water of the Köröses gets to the Tisza united in the Triple-Körös. This is the largest water system of the Middle Tisza region and one of the most interesting water systems of the Carpathian basin.

The watershed area of the Köröses may be considered as a square. It is limited by the lines drawn in the West in the direction of Tiszalök–Kunhegyes–Csongrád; in the North in that of Tiszalök- the Rumanian Nagykároly–Tasnád; in the East Tasnád–Rudabánya; in the South Világos–Orosháza–Csongrád.

The length of the river White-Körös is 236 km, of which 9 km flow on the territory of our country. In its mountain stretch it is nourished by several brooks. The Black-Körös is 168 km long, of which 4 km are at the frontier, 16 km flow on the territory of our country, taking in many right-side and left-side affluents, thus among others the Hortobágy, as well. The length of the Rapid-Körös is 209 km, of which 59 are on Hungarian territory. The Rapid-Körös takes in the Berettyó in the South of Szeghalom and then unites with the Double-Körös below Körösladány. One has also to reckon here, apart from the rivers, with the inland channels, as well.

The whole watershed area is about 22,715 square km. From this area 9,351 sq.km belung under the supervision of the Water Administration of the Lower Tisza Region. The largest water output of this part is 1,585 cubic m/sec, and the smallest one is 2 cubic m/sec. The water system is taken in by the Tisza at river-km 242.3.

The water examinations were performed out of samples taken at two sites. One of our sampling sites was in the Triple-Körös at Kunszentmárton, at river-km 19.8, the other one at Magyartés, at river-km 2.0. The sampling site at Magyartés is No.1 and that at Kunszentmárton is No. 2. In Fig. 1, the sappling sites are shown.

Similarly to the examination of the water of the Tisza (FÜGEDI 1978), in the earlier years, we have taken water samples in several places (bridge at Gyoma, Békésszentandrás). The use of several sampling sites was not justified on the basis of analyses. Further on, therefore, the water samples were only taken at two sites (Fig. 1).

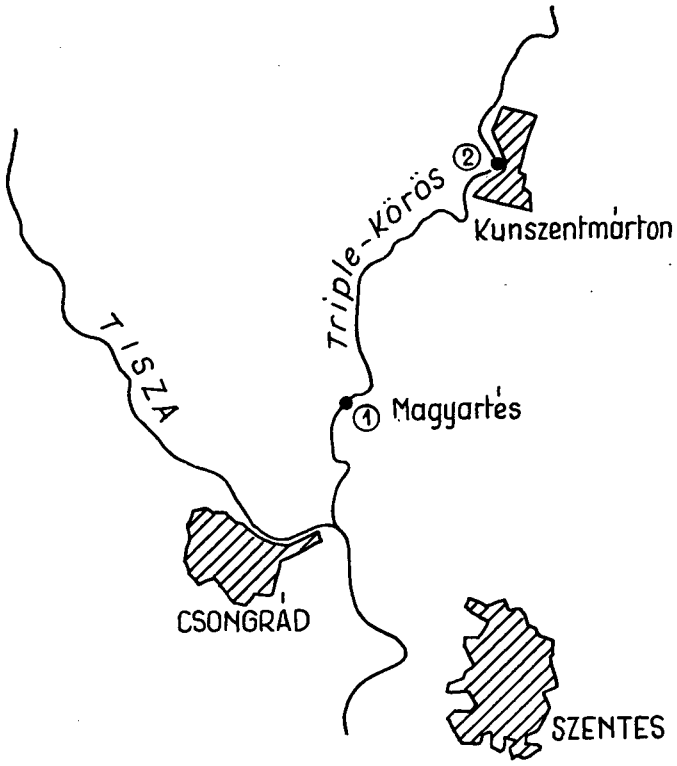

Fig. 1. Sampling sites in the Triple-Körös.

A survey and discussion of the results of investigations

The water of the Triple-Körös was systematically investigated on the basis of samples taken from the two sampling sites between 1970 and 1977. The evaluation of water according to use was carried out on the basis of the COMECON standard (FÜGEDI 1978).

Evaluation of the water of the Triple-Körös according to utilization

	Sampling site 1 Magyartés	Sampling site 2 Kuszentmárton
Communal water supply	I	II
Industrial water supply	I	I
Agricultural water supply		
(a) Irrigation	I	I
(b) Fish husbandry	I	II

In the following, the data of sampling site 1 (Magyartés), the formation of the indices investigated are shown in Fig. 2 and the data of sampling site 2 (Kunszentmárton).

Figure are showing the oxygen household in the water of the Triple-Körös. The solute oxygen content developed similarly to that in the Tisza water, under like conditions (K. FÜGEDI, H. MÉSZÁROS 1978). A considerable difference could, anyway, be observed above the river barrage at Békésszentandrás when the saturation value

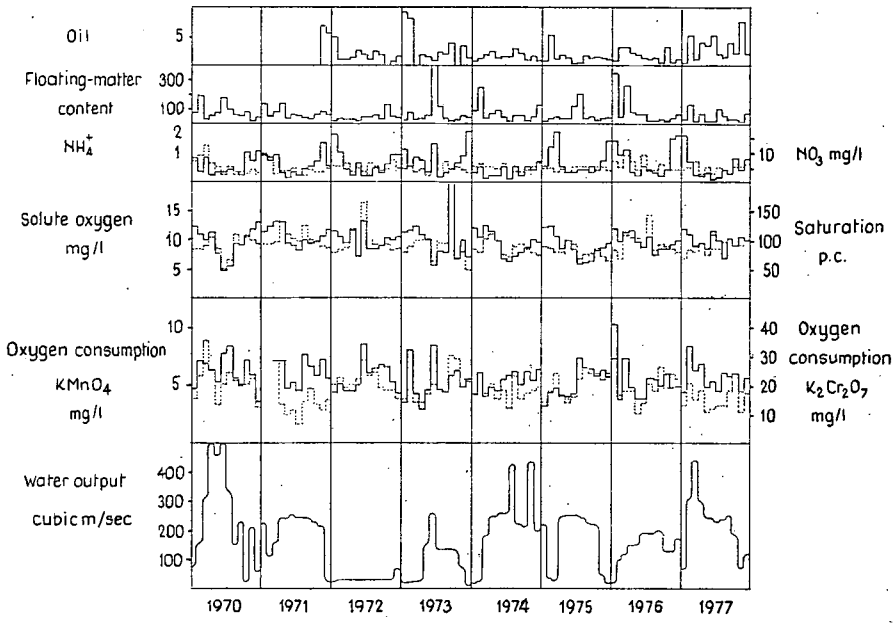

Fig. 2. Investigation data of sampling site 1 (Magyartés).

reached even 189 percent. This high value may have been brought about by the biological overproduction. The river reaches are here of standing water character. It is shown by the data both of the sampling place at Magyartés and that of Kunszentmárton that there is still enough solute oxygen in the river.

We could observe at our sampling place 2 (Kunszentmárton) that the samples taken from the streamline of the river differred from those taken from places close to the riverside. In the parts close to the riverside the sewage-water of the large village inflows — and by this the quantity of the solute oxygen was reduced, and the pollution became larger, as well.

For establishing water pollution, it is most wide-spread to measure oxygen consumption with potassium permanganate and potassium dichromate (FÜGEDI 1978). If there are only easily oxidizable matters in water, then the oxygen-consumption values of the two kinds of measuring agree with each other. At the presence of difficultly oxidizable matters, however, the value of the potassium dichromatic oxygen consumption is higher. The value of oxygen consumption measured with potassium permanganate did not exceed, at any sampling site, the value 10 mg/l. The lowest value measured was 2.8 mg/l.

The organic-matter pollution of the Triple-Körös has not increased in proportion as it was observed in case of the Tisza (K. FÜGEDI, H. MÉSZÁROS 1978). The quantity of organic matter increases very slowly, the water quality is, therefore, first class.

This river water is, according to kation water type, Ca–Mg, rarely Ca, but there occurs type Ca–Na, as well. From among anions, HC_3 is dominant but there occurs CO_3, too. The halobity of water means the totality of inorganic compounds that are important from biological point of view. Halobity is determined by the geochemical properties of the river bed and the watershed area. The living beings can hardly make any change in this well-determining factor. They generally accomodate themselves to the salts in different concentrations (FELFÖLDY 1974). The salt content of the Triple-Körös is lower than that of the Tisza, its value being about 250 mg/l. In the course of our investigations there were measured 400 mg/l maximum and 140 mg/l minimum salt quantities.

Floating matter is in this water: very fin sand and silt. The amount of the latter is, however, not considerable. The annual deposit transport of the Köröses is also small. There gets, therefore, into the Triple-Körös, too, a minimum deposit. The Triple-Körös flows, in general, at an identical level. This has also in a certain sense influence on that the sediment transport is very low. In the upper reaches of the Köröses — where there are great level-differences in their flowing — the alluvial deposit is fine grained and in the lower reaches there is no rolled grain at all to be found. Compared with other water courses of similar size, the deposit transfer of the Köröses is the smallest. The water output and floating-matter content show a close connection. Outstanding values can be seen for 2 to 3 days after floods.

Investigating into the nitrogen household in Figures, we can establish that the ion content of ammonia does not depend upon the water-level. Instead of the outstanding values measured in the large river systems on certain occassions, here we generally measured lower values (1.4–0.5 mg/l). The increase in the use of artificial fertilizers is connected with the development of agriculture both in this country and abroad. The utilization of artificial fertilizers increases in the watershed area of the Tisza–Körös–Maros, as well. The most important fertilizers are nitrate and phosphorus. — In the water samples, the nitrate content shows a little rise. There are some outstanding data — with the presence of a major quantity of nitrate — when a frozen ground was strewn with the artificial fertilizer which got into the river by erosion.

The phosphorus loading of the water of the Triple-Körös was only investigated for two years. This is, at any rate, a short time to draw essential conclusions and give generelizations. Nevertheless, it may be established that the nitrate content of water was augmented by the increasing use of fertilizers. This however is not dangerous, as yet, either for the use of water or from ecological point of view.

Of late years, we have met newer water-polluting materials: mineral oil and its derivatives. The damaging effect of these is in that they spread in a thin layer on the surface of water and prevent oxygen uptake. The thickness of such an oil layer is one or more microns. — Oil is particularly dangerous to fishes because it covers gills and impedes breathing. If oil is absorved in the alimentary canal of fishes, this deteriorates the taste of flesh. Apart from this, oil damages the riverside, too, impedes recreation and water sports.

The water of the Köröses is not polluted so much with oil, as yet, as the Danube and the Tisza. But we are reminded by the values of the analysis of that, if only in a small degree, oil pollution is continuous.

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Vízvizsgálatok a Hármas-Körösön

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Kivonat

A Hármas-Körös vizének minőségét vizsgáltuk Magyartés és Kunszentmárton mellett vett mintákból. Megállapíthattuk azt, hogy a Hármas-Körös vize Magyartés mintavételi helyen minden hasznosítási szempontból első osztályú. Kunszentmártonnál vett vízminták azt mutatták, hogy a beömlő szennyvíz befolyásolta a víz minőségét. A hétéves vizsgálat alapján látható, hogy a Hármas-Körös a legtisztább folyóvizünk, szennyeződése igen kismértékű.

Istraživanja na rekama Hármas-Körös

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Abstract

Istraživanja kvaliteta voda na rekama Hármas-Körös vršena su iz proba uzetih pored Magyartés i Kunszentmárton. Utvrdjeno je da je voda Hármas-Körös kod Magyartés po kvalitetu prvorazredna i pogodna za svaku upotrebu. Probe sa područja Kunszentmárton pokazale su da otpadne vode utiču na kvalitet vode. Na osnovu sedmogodišnjeg ispitivanja vidljivo je da je Hármas-Körös najčistija tekuća voda NR Madjarske, njeno zagadjivanje je neznatno.

Анализ воды реки Хармаш-Кёрёш

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Нами был проведен анализ качества воды реки Хармаш-Кёрёш по пробам, взятым в районе Мадяртыш и Кунсентмартон. Установлено, что вода реки Хармаш-Кёрёш в районе взятия пробы у Мадяртыш является первоклассной со всех точек зрения использования. Пробы воды, взятые у Кунсентмартона, показывают, что притекающая сюда грязная вода оказывает влияние на качество воды. Как показывают результаты проведенных нами в течение семи лет анализов, Хармаш-Кёрёш является самой чистой рекой Венгрии, загрязнённость воды здесь очень незначительна.

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SALMONELLAE IN THE SURFACE WATERS OF CSONGRÁD COUNTY

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Abstract

Authors studied obligate and facultative fecal bacteria in the surface waters of Csongrád county from 1976 to 1977. Samples were taken monthly in general. In this paper, however, only the *Salmonella* pollution of the Tisza and its tributaries are reported. From June, 1976 to December, 1977, 317 water samples were enriched for the purpose of *Salmonella* examinations.

During 1976, 173 *Salmonella* strains were isolated and found to belong to 26 serotypes.

In 1977, 295 *Salmonella* strains were isolated and these belonged to 30 serotypes.

The *Salmonella* infection of the surface waters of Csongrád county as well as the spatial and time distribution of isolated Salmonella serotypes are demonstrated in figures and tables.

Introduction

In the previous years new tasks have become evident concerning evaluation and comparative analysis of the quality of surface waters. Besides the quantitative demand for water supply, water quality has become the minimum factor of water use. In the case of water utilizations, that require the judgement of the health organs, the quantitative and qualitative determination of obligate fecal indicator bacteria is indispensable.

According to our present knowledge (DEÁK 1977), the obligate fecal indicators of surface waters are the following: fecal coliforms, *Streptococcus faecalis* resp. *fecal streptococci,* the so called "enteral phages" which dissolve the intestinal bacteria, and finally pathogenic bacteria as salmonellas.

In this paper only the *Salmonella* infection of water bodies in Csongrád county will be discussed.

The Salmonella infection of the reach of the Tisza in Csongrád county as well as its tributaries was reported by DEÁK and SCHIEFNER (1975). They have stated that in Csongrád the *Salmonella* positivity of the Tisza has only in the area of Algyő and Szeged approached a value of 60%. The water quality of the Maros and Hármas-Körös was found by them favourable.

Materials and Methods

Between June, 1976 and December, 1977, 317 samples collected from the surface waters of Csongrád county were enriched for *Salmonella* examinations.

Water samples were usually taken in each month at the following sampling places: (Fig. 1).

Table 1. *Salmonella serotypes occurring in the water-body of the Tisza in Csongrád county during 1976*

Sampling place	July	Aug	Sept	Oct	Nov	Dec	Number of strains	Serotypes
Csongrád	–	–	–	–	*S. meleagridis* 3	*S. brandenburg* 8	11	2
Szentes	–	–	*S. london* 4	–	*S. agona* 1 *S. derby* 1	*S. java* 4	10	4
Mindszent	–	–	*S. derby* 4	*S. derby* 1 *S. brandenburg* 2 *S. livingstone* 2	*S. agona* 2 *S. essen* 2	–	13	
Tápé	–	–	–	*S. abony* 1 *S. brandenburg* 1 *S. london* 1	–	–	3	3
Szeged strand	–	*S. bovismorbificans* 3 *S. westhampton* 2	*S. typhimurium* 1	*S. london* 2 *S. abony* 4 *S. java* 1	*S. london* 4	– –	17 17	6 6
Tiszasziget frontier	–	*S. derby* 12 *S. infantis* 9 *S. give* 2 *S. london* 2 *S. westhampton* 2 *S. senften* 1 *S. stanley* 1	*S. london* 1 *S. anatum* 2	*S. abony* 5 *S. java* 1	*S. enteritidis* 2	*S. london* 9	49	11
Total	–	34 9 serotypes	12 4 serotypes	21 6 serotypes	15 6 serotypes	21 3 serotypes	103	16

The longitudinal section of the Tisza was sampled between 246.0–162.5 riv km (riv km=river kilometer). Sampling places were as follows: Csongrád, pontoon-bridge 246.0 riv km; Szentes, railway-bridge 242.0 riv km; Mindszent, ferry 216.2 riv km; Tápé 177.5 riv km; Szeged strand and Tiszasziget; Hungarian–Yougoslavian frontier region 162.5 riv km.

The two major tributaries of the Tisza were sampled, too. The river Hármas-Körös was sampled at its mouth, at 2 riv km. Maros was sampled at three places, in its reach above Makó, i. e. at the strand, at the bridge below the town (30 riv km) and at 2 riv km before its discharge into the Tisza. The water of Kurca canal was sampled above and below Szentes. It is this canal of little flow volume that collects both purified and nonpurified sewage of the town Szentes and discharges into the Tisza.

Szárazér canal and Élővíz canal flow into the frontier section of the Maros. In the period of water utilization, samples were also taken from these canals, just for the sake of orientation, during 1977. Because of the Tisza regulation, more than one back-water is to be found in Csongrád county. Samples were collected from four of these stagnant waters at the following localities: Csongrád-Serházzugi, Mártély, Körtvélyes and Atka.

For the purpose of Salmonella studies, 1000 ml water sample was collected at about 20 cm below surface from the current (in the case of rivers).

The standing waters, i. e. stagnant waters were sampled from the molo or a boat. During transportation to the laboratory, the samples were kept cold and worked up on the day of sampling, or within 24 hours at the latest. For the purpose of Salmonella examinations, 1000 ml water sample was filtered though 0.45 membrane filter and placed either into Preuss enrichment media containing kalium tetrationate or Rappaport enrichment media and was incubated there at 37 °C for 16–18 h.

Samples taken from the enrichment media following an incubation period of 24 resp. 48 h, were plated by using brillant gren-, bismuth sulfite- and dezoxicholate citrate-containing media. Differentiating and selective solid media were incubated at 37 °C for 24 h. Colonies suspicious of *Salmonella* were isolated on Russel media. Strains belonging to Salmonella were identified by the usual biochemical and serological tests.

Results

Results of *Salmonella* examinations during 1976: Number and serotypes of *Salmonella* strains isolated along the longitudinal section of the Tisza between Csongrád and Tiszasziget frontiers are illustrated according to sampling places and in monthly distribution (Table 1). As seen from the table, only three *Salmonella* strains were isolated in the area of Tápé, which, however, belonged to three different serotypes. The Csongrád water area of the Tisza became only in November salmonella-positive. From the sampling place at Csongrád in November only *S. meleagridis,* in December only *S. brandenburg* could be isolated. *S. meleagridis* was collected only at 246.0 riv km from the Tisza in Csongrád. As shown in Table 1, the Szeged strand and the frontier area at Tiszasziget were the "richest" in salmonellas, particularly during August, when 34 *Salmonella* strains, belonging to 8 serotypes, were isolated from the water samples collected in these two sampling places. It could be also stated, that the majority of *Salmonella* strains and serotypes were isolated from these two sampling places in the half year period. It must be mentioned, that the trialoperation of the dam weir at Ó-Becse was started in the Yougoslavian reach of the Tisza at the end of July — at the beginning of August, 1976. Because of the impoundment, the flow rate of the Tisza considerably decreased at Szeged. The effect produced by this circumstance on the microbiological conditions in the river was unfavourable in every respect. This is supported by studies on other bacteriological parameters, too. (The results of these studies will be reported in another paper.)

In the next table (Table 2) numbers and serotypes of salmonellas isolated along the longitudinal section of the Csongrád reach of the Tisza are seen in the order of their frequency.

From June, 1976 to December 1976, *Salmonella london* was the most frequent serotype, followed by *S. derby, brandenburg, abony.* In Hungary this great frequency

Table 2. *Numbers and serotypes of Salmonella strains isolated from the water body of the Tisza from July, 1976*

	Salmonella strains	
	Serotypes	Number
1.	*S. london*	23
2.	*S. derby*	18
3.	*S. brandenburg*	11
4.	*S. abony*	10
5.	*S. infantis*	9
6.	*S. java*	6
7.	*S. westhampton*	4
8.	*S. agona*	3
9.	*S. bovis-morbificans*	3
10.	*S. meleagridis*	3
11.	*S. anatum*	2
12.	*S. enteritidis*	2
13.	*S. essen*	2
14.	*S. give*	2
15.	*S. livingstone*	2
16.	*S. senftenberg*	1
17.	*S. stanley*	1
18.	*S. typhi-murium*	1
	Total:	113

of *S. london* was only restricted to Csongrád county. Concerning the *S. london* epidemy, we may say the following. In Hungary the *S. london* serotype was first isolated from human material in 1963. In Csongrád county this serotype was recovered in 1972, and subsequently there were three positive cases also from human material in 1975. The first case of the great epidemy in Szeged was isolated in the Laboratory of Enteric Bacteriae on July 30, 1976. Thereafter, there were no positive cases for about two weeks. From the middle of August, 1976, the number of the cases caused by *S. london* in Szeged increased considerably. The *S. london* serotype was isolated from foodstuff at the Laboratory of Food Bacteriology on August 16. One day later, on August 17, 1976, *S. london* was also isolated in the Laboratory of Water Biology from water samples taken from the current of the Tisza, the frontier region of Tiszasziget.

It is known that the sewage of Szeged is discharged unpurified into the swiftest part of the Tisza, below the city, at about 2–3 riv km above our sampling place. Since there was an increase in *S. london* positive cases in human material, isolations from water samples taken from the Tisza were continued in the second half of the year, as well. Since Szeged and its attraction area was the center of the *S. london* epidemy, most *S. london* strains were isolated from the Szeged reach of the Tisza.

Along the longitudinal section of the Tisza seldom occurring serotypes were found: *S. senftenberg, S. stanley* and *S. typhi-murium*. *S. typhi-murium* (Tabl. 1) was isolated only once, in the area of Szeged strand, despite the fact that it was the second place where it was isolated from by the Laboratory of Enteric Bacteriae in 1976. Next table (Table 3) shows *Salmonella* strains found in and isolated from the longitudinal section of the Csongrád reach of the Maros, in monthly distribution and according to sampling places. During half a year 56 Salmonella strains were isolated from three sampling places. All the three sampling places were positive for *Salmonella* during October and November. Serial examinations showed *Salmonella* positivity to be 53.5% in the water ot the Maros river.

Table 3. *Numbers and serotypes of Salmonella strains isolated in the longitudinal section of the Maros river in 1976*

Sampling place	June	July	Aug	Sept	Oct	Nov	Dec	Number of Salmonella strains
Maros and Makó strand	*S. enteritidis* 3 *S. typhimurium* 1	–	–	*S. manchester* 6	*S. derby* 1 *S. agona* 4 *S. manchester* 1 *S. java* 1	*S. derby* 3 *S. agona* 1 *S. manchester* 1 *S. give* 2 *S. heidelberg* 1	*S. senftenberg* 3	28
Makó and Maros bridge	*S. reading* 3	–	–	*S. manchester* 5 *S. bredeney* 1	*S. derby* 2 *S. agona* 2 *S. essen* 2	*S. manchester* 1 *S. heidelberg* 1	–	17
Maros 2 riv km	–	–	–	*S. heidelberg* 1	*S. derby* 2 *S. abony* 1 *S. java* 2 *S. heidelberg* 1 *S. brandenburg* 1	*S. anatum* 3	–	11
	7	–	–	13	20	13	3	56

The serotypes, *S. manchester* and *S. heidelberg* could be continuously isolated from the water of the Maros, from September to November. Similarly to the Tisza, *S. typhi-murium* was isolated only on one occassion, namely from the sampling place at Makó-strand.

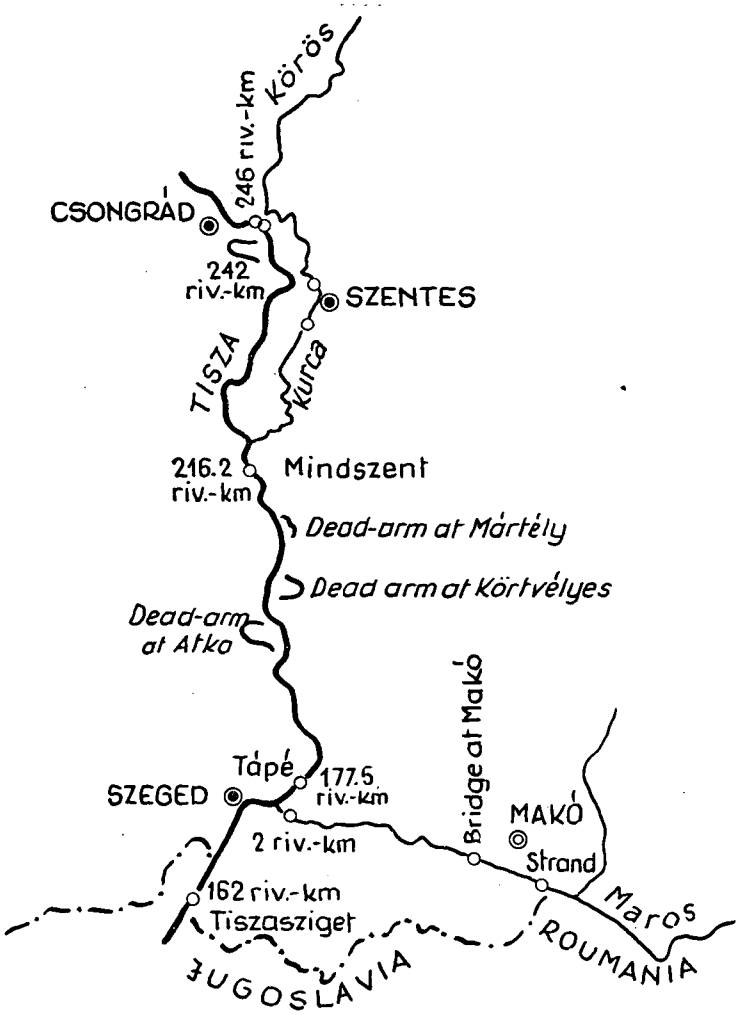

Fig. 1. Surface waters of Csongrád county with the sampling places.

In Table 4 *Salmonella* serotypes isolated along the Csongrád reach of the Maros are summarized in the order of their frequencies and occurrences. *Salmonella manchester* proved to be the most frequent serotype. It was isolated from the Maros in 1976. The *S. london* serotype was not isolated from the Maros during 1976.

In 1976, the Kurca canal was only tentatively sampled, since it is the recipient of the effluent discharged from the Central Sewage Treatment Plant of Szentes. The effluent is discharged into Kurca canal below the town. The water in Kurca canal

was Salmonella-positive at both sampling places. The following serotypes were isolated from above Szentes: *S. derby, S. senftengerg, S. saint-paul.* Below Szentes *S. reading* (0_5 deficiency), *S. derby* (0_5 deficiency) serotypes were isolated from the canal. The effluent of the sewage purification plant was also examined for Salmonella

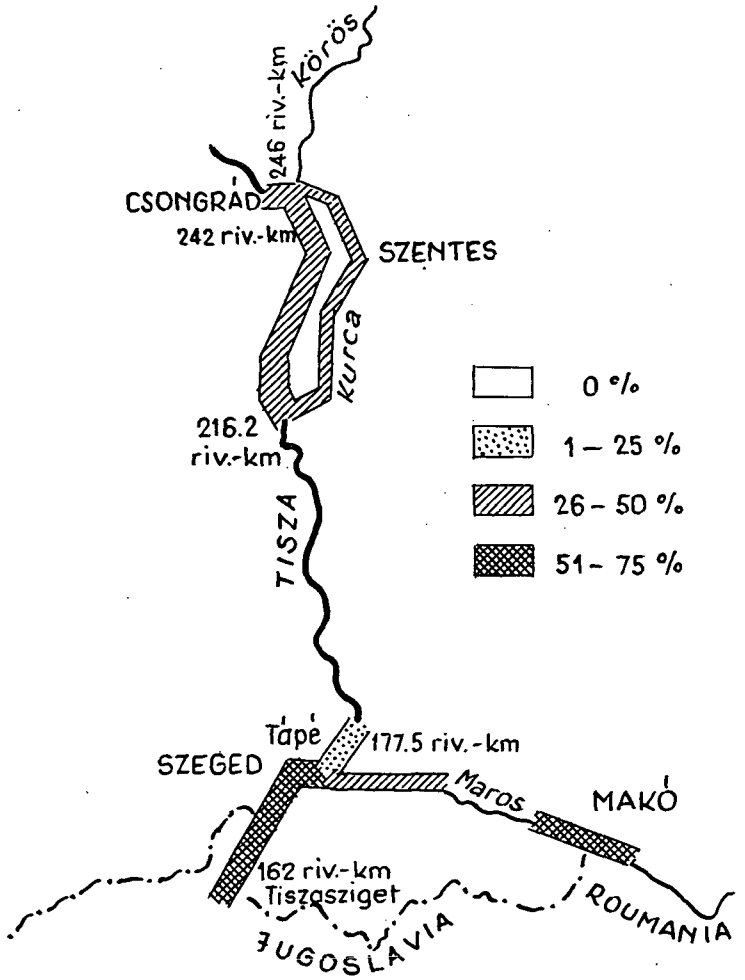

Fig. 2. Occurrence of salmonellas in the Tisza and its tributaries.

simultaneously. 0_5 antigen-deficient Salmonella reading was isolated from the effluent, too. During 1976, only back-waters of the Tisza at Körtvélyes and Mártély were sampled. The following serotypes were isolated from the back-water of the Tisza at Körtvélyes: *S. reading* (0_5-positive), *S. schleissheim, S. arizonae* (38; r; z.).

Only on one occasion was salmonella isolated from the backwater of the Tisza at Mártély during 1976. The species was S. agona.

The percentual frequency of salmonellae are illustrated on the basis of serial examinations performed in the surface waters of Csongrád county (Fig. 2).

On no occasion were salmonellas isolated from the 1000 ml samples taken from the water of the Hármas-Körös (2 riv km) during the half year in 1976. In the longitudinal section of the Tisza Salmonella-positivity was most favourable in the water region of Tápé. The other reaches of the Tisza, as well as the Maros and the Kurca were heavily infected by Salmonella. This fact is all the more remarkable, because along the longitudinal sections of the two rivers, open-air baths are functioning and recreation areas have been established. The Plan of Sectorial Normalization contains guide lines concerning utilization of surface waters and determines the limiting value of *Salmonella*-positivity, too, by stating, that "... in surface waters of I. and II. order, water quality may be suitable if in the 1000 ml samples taken from defined and characteristic place or places, and conforming to other bacteriological limiting values upon the evidence of serial examinations performed in the period of water utilization, the frequency of salmonellas is less than 33%".

The results of Salmonella examinations during 1977 were the following:

Numbers and serotypes of *Salmonella* strains isolated from the longitudinal section of the Tisza in Csongrád county are shown in Table 5, in monthly distribution and according to sampling places.

From the 1000 ml water samples collected along the longitudinal section of the Tisza no *Salmonella* strains could be isolated in March and October. In 1977, *Salmonella* positivity was the highest in the Csongrád and Mindszent region of the Tisza. Compared to 1976, *Salmonella* infection took an unfavourable turn in the Tápé reach of the Tisza. In comparison to the 16.6% positivity of the preceding year, the positivity of this water region increased to 33.3% during 1977. The deterioration of water quality at this sampling place is also supported by other bacteriological parameters. During 1977, *Salmonella* positivity was 49.3% in average, and at each sampling place, except Tápé, exceeded the limiting value of 33.3%. *Salmonella* strains isolated from the longitudinal section of the Tisza in Csongrád county during 1977 are illustrated in Table 6 in the order of their frequencies.

Along the longitudinal section of the Tisza the following *Salmonella* serotypes were the most frequent ones: *S. derby, S. give, S. agona.* Among the *S. derby* serotypes O_5-positive and O_5-antigen deficient serotypes equally occurred.

Table 4. *Numbers and serotypes of Salmonella strains isolated from the longitudinal section of the river Maros, in the order of their occurrences and frequencies (1976)*

	Salmonella strains	
	Serotypes	Number
1.	*S. manchester*	15
2.	*S. derby*	8
3.	*S. agona*	7
4.	*S. heidelberg*	4
5.	*S. anatum*	3
6.	*S. enteritidis*	3
7.	*S. java*	3
8.	*S. reading*	3
9.	*S. senftenberg*	3
10.	*S. essen*	2
11.	*S. abony*	1
12.	*S. brandenburg*	1
13.	*S. bredeney*	1
14.	*S. give*	1
15.	*S. typhi-murium*	1
	Total:	56

Table 5. *Special and time distribution of Salmonella strains isolated in the longitudinal section of the Tisza in Csongrád county in 1977*

Sampling places	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Csongrád 246.0 riv km	*S. derby* 1	–	–	*S. derby* 1	*S. derby* 3	*S. derby* 3	*S. give* 7	–	–	*S. derby* 2 *S. hadar* 2	*S. panama* 2	22
Szentes	*S. enteritidis* 2 *S. typhimurium* 4	–	–	*S. derby* 6	*S. reading* 2	*S. derby* 6	*S. derby* 1	*S. typhimurium* 2	–	–	–	23
Mindszent 216.2 riv km	*S. java* 2	–	*S. westhampton* 3	*S. typhimurium* 1 *riy* 1	–	*S. derby* 2 *S. give* 1	*S. agona* 2	–	–	*S. derby* 1 *S. london* 1	–	14
Tápé 172.5 riv km	*S. brandenburg* 5 *S. give* 2 *S. abony* 1	–	–	*S. derby* 1	–	–	*S. derby* 5 *S. agona* 3	–	–	*S. derby* 5 *S. hadar* 1	*S. anatum* 3	26
Szeged strand	–	–	–	*S. heidelberg* 9	–	–	–	*S. agona* 2	–	*S. agona* 2	*S. newport* 1	14
Tiszasziget frontier 162.5 riv km	*S. derby* 3 *S. enteritidis* 3	–	–	–	*S. derby* 1	*S. westhampton* 1 *S. solt* 1	–	*S. westhampton* 1	–	–	–	10
	24	–	3	19	6	14	18	5	–	14	6	109

Serotypes that were isolated for the first time from the longitudinal section of the Tisza in Csongrád are the following: *S. hadar, S. newport* and *S. solt*.

In 1976, the frequency of *S. london* was the highest in the Tisza region, owing to the *S. london* epidemy. In 1977, however, it was found among the seldom occurring serotypes. *S. london* was only once isolated from the Tisza, i. e. in November, at the sampling place at Mindszent (Table 5). In 1977, 79 salmonellas, belonging to 17 serotypes, were isolated from samples collected along the longitudinal section of the Maros (Table 7).

On the basis of serial examinations, *Salmonella*-positivity of the Maros averaged 57.9% in 1977. From water samples of 1000 ml from the sampling place at the bridge of Makó, *Salmonella* was only missing in October.

From the reach examined, *S. panama* was isolated in greatest number, and its outburst fell on January and February. In January, the isolated *Salmonella panama* strains were dulcite negative, in February dulcite-positive biochemical variants. From water samples collected from the Maros, *S. agona* was also isolated in great numbers and the presence of this serotype persisted in the river water for a long time, from February to November. *S. mapo* was the new *Salmonella* serotype which was first isolated in Csongrád county.

In Kurca canal the water was unfavourable in 1977. During 1977, Kurca canal was sampled monthly, at both sampling places, and on the basis of serial examinations *Salmonella*-positivity proved to be 54.2%. 52 *Salmonella* strains, belonging to 9 serotypes were isolated from the two sampling places. Numbers and serotypes of the isolated Salmonella strains are illustrated in Table 8.

In water samples from Kurca canal above Szentes, the 0_5-positive and 0_5-antigen deficient variants of S. derby occurred with the greatest frequency. The 0_5-positive variants of *S. bareilly, S. give, S. typhi-murium* and *S. reading* were less frequent serotypes in this sampling place. *S. langensalza* serotype was isolated from this sampling place for the first time. From the section of the canal below Szentes only the *S. panama* serotype was isolated. This was a dulcite-negative biochemical variant. From Juni to November, however, only *S. hadar* was typified from the water samples and it was also dulcite-negative.

Numbers and serotypes of Salmonella strains isolated from the Élővíz and Szárazér canals are shown in Table 8.

From the two samples taken from Élővíz canal 7 salmonellas belonging to four serotypes, were isolated. Only two samples were taken from the water of the Szárazér canal, and from them 18 Salmonella strains were isolated, which belonged to 8 serotypes. In Csongrád county the *S. isangi* serotype was first isolated from the Szárazér canal during October (6. 7; d; 1, 5), and a month later it was also typified from the Élővíz canal.

Analyzing the *Salmonella* infection in the backwaters of the Tisza, it could be stated that in no instance were positivities in the water regions in excess of the 33.3% limiting value. A comparative table (Table 8) illustrates numbers and serotypes of the isolated *Salmonella* strains.

Most salmonellas were isolated from samples taken from the back-water of the Tisza at Csongrád-Serházzugi. Serial examinations during 1977 showed *Salmonella*-positivity to be 33.3% in average. The serotype *S. hadar* was isolated in greatest number. It was first isolated in Csongrád county in the Laboratory for Water Bacteriology from a water sample taken from the back-water of the Tisza on June 30, 1977. A week later the same serotype was isolated from patients in the Laboratory of Enteric Bacteriae. The *S. hadar* serotype showed an increased frequency in the surface waters

Table 6. *Numbers and serotypes of Salmonella strains isolated from water of the Tisza in the order of their frequencies in 1977*

	Salmonella strains	
	Serotypes	Number
1.	*S. derby*	42
2.	*S. give*	10
3.	*S. agona*	9
4.	*S. heidelberg*	9
5.	*S. typhi-murium*	8
6.	*S. brandenburg*	5
7.	*S. enteritidis*	5
8.	*S. westhampton*	5
9.	*S. anatum*	3
10.	*S. hadar*	3
11.	*S. java*	2
12.	*S. panama*	2
13.	*S. reading*	2
14.	*S. abony*	1
15.	*S. london*	1
16.	*S. newport*	1
17.	*S. solt*	1
	Total:	109

of Csongrád county in the second half of the year. The serotype *S. hadar* was also isolated from the longitudinal section of the Tisza, and from the Kurca canal below Szentes.

In 1977, *Salmonella*-positivity was 16.6% in the back-waters of the Tisza at

Table 7. *Numbers and serotypes of Salmonella strains isolated from the longitudinal section of the Maros river, in the order of their frequencies in 1977*

	Salmonella strains	
	Serotypes	Number
1.	*S. panama*	19
2.	*S. agona*	16
3.	*S. anatum*	8
4.	*S. java*	6
5.	*S. manchester*	6
6.	*S. westhampton*	5
7.	*S. thompson*	4
8.	*S. derby*	3
9.	*S. enteritidis*	2
10.	*S. livingstone*	2
11.	*S. typhi-murium*	2
12.	*S. bovis-morbificans*	1
13.	*S. essen*	1
14.	*S. kapemba*	1
15.	*S. london*	1
16.	*S. mapo*	1
17.	*S. meleagridis*	1
	Total:	79

Mártély and Körtvélyes. A comparative table illustrates numbers and serotypes of salmonellas isolated from the two back-waters (Fig. 8).

Water samples taken from the back-water of the Tisza at Mártély in February and November were *Salmonella*-positive. In both cases *S. typhi-murium* strains were isolated, which differed in phage and biotype. The phage type of the strains isolated in February was not to be determined, they belonged to biotype 3. The *S. typhi-murium* strains isolated from the Tisza in the same period showed the same phage type and biotype. The *S. typhi-murium* strains isolated from the back-water of the Tisza at Mártély belonged to phage type 1a var. 1d and biotype 2.

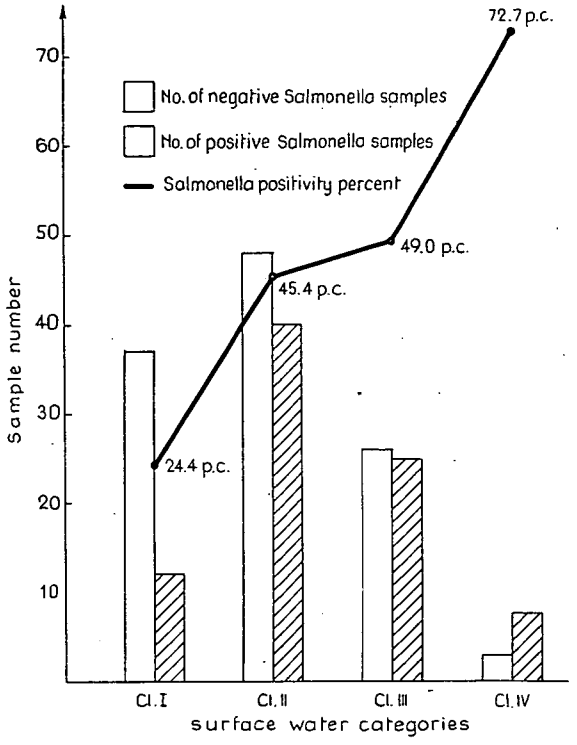

Fig. 3. Salmonella-positivity in surface waters of different categories.

From the back-water of the Tisza at Körtvélyes also only *S. typhi-murium* could be isolated. These isolates had 0_5-deficient antigenic structure.

The back-water of the Tisza at Atka is a water region which is intensively populated with fish. Its water was never *Salmonella*-positive during the one year period. Then, at the end of July, the serotype *S. gallinarum-pullorum,* not isolated yet in serotype was also isolated in the Laboratory of Enteric Bacteriae from humans, subsequent to isolation from water.

In Csongrád county, the frequency of *Salmonella*-positivity in surface waters of different categories were also examined (Fig. 3). In the determination of water

quality three bacteriological parameters were considered, according to the following limiting values:

Classes of water quality	I	II	III	IV
Number of coliforms pro ml	0—10	10—100	100—1000	above 1000
Number of fecal coliforms pro ml	0—1	1—10	10—100	above 100
Number of fecal streptotocci pro ml	0—1	1—10	10—100	above 100

Table 8. *Salmonella strains isolated from the surface waters in Csongrád county in 1977*

	Tisza	Hármas Körös	Kurca	Maros	Élővíz	Szárazér	Mártély dead-arm	Körtvélyes dead-arm	Serházzúg dead-arm	Atka dead-arm	
1. *S. derby*	42	–	9	3	–	4	–	–	–	–	58
2. *S. panama*	2	–	13	19	–	4	–	–	–	–	34
3. *S. agona*	9	–	3	16	2	2	–	–	–	–	32
4. *S. typhi-murium*	8	5	2	2	3	–	6	5	1		32
5. *S. hadar*	3	–	15	–	–	–	–	–	6	–	24
6. *S. anatum*	3	–	3	8	–	2	–	–	–	–	16
7. *S. give*	10	–	2	–	–	–	–	–	–	–	12
8. *S. infantis*	–	4	–	–	–	5	–	–	1	–	10
9. *S. westhampton*	5	–	–	5	–	–	–	–	–	–	10
10. *S. heidelberg*	9	–	–	–	–	–	–	–	–	–	9
11. *S. java*	2	–	–	6	–	–	–	–	–	–	8
12. *S. enteritidis*	5	–	–	2	–	–	–	–	–	–	7
13. *S. manchester*	–	–	–	6	–	–	–	–	–	–	6
14. *S. brandenburg*	5	–	–	–	–	–	–	–	–	–	5
15. *S. reading*	2	–	3	–	–	–	–	–	–	–	5
16. *S. livingstone*	–	–	–	2	–	2	–	–	–	–	4
17. *S. thompson*	–	–	–	4	–	–	–	–	–	–	4
18. *S. kapemba*	–	–	–	1	–	2	–	–	–	–	3
19. *S. london*	1	1	–	1	–	–	–	–	–	–	3
20. *S. isangi*	–	–	–	–	1	1	–	–	–	–	2
21. *S. meleagridis*	–	–	–	1	1	–	–	–	–	–	2
22. *S. abony*	1	–	–	–	–	–	–	–	–	–	1
23. *S. bareilly*	–	–	1	–	–	–	–	–	–	–	1
24. *S. bovis-morbificans*	–	–	–	1	–	–	–	–	–	–	1
25. *S. essen*	–	–	–	1	–	–	–	–	–	–	1
26. *S. gallinarum-pullorum*	–	–	–	–	–	–	–	–	–	1	1
27. *S. langensalsa*	–	–	1	–	–	–	–	–	–	–	1
28. *S. mapo*	–	–	–	1	–	–	–	–	–	–	1
29. *S. newport*	1	–	–	–	–	–	–	–	–	–	1
30. *S. solt*	1	–	–	–	–	–	–	–	–	–	1
Total:	109	10	52	79	7	18	6	5	8	1	295

It is seen in Fig. 3 that in surface waters of pure quality belonging to the first class, the frequency of Salmonellas was 24.4%. Evidently, in surface waters of the IV. class was Salmonella-positivity the highest, i.e. 72.7% in our case. In waters of

he II. and III. category, *Salmonella*-positivity of the samples was nearly identical, i.e. in waters of the II. category 45.4% of the samples were positive, in those of the III. category 49.0% of the samples.

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Salmonella baktériumok előfordulása Csongrád megye felszíni vizeiben

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Kivonat

A Szerzők Csongrád megye felszíni vizeiből 1976—1977. években általában havi gyakorisággal elvégezték az obligát és fakultatív faecal indikátor baktériumok meghatározását. Jelen közleményükben azonban csak a Tisza és mellékvizeinek Salmonella szennyezettségéről tájékoztatnak. 1976. júniusától 1977. decemberéig 317 vízmintát dúsítottak be a Salmonella vizsgálatok céljára.

1976-ban 173 salmonella törzset izoláltak és ezek 26 szerotípusba tartoztak.

1977-ben 295 salmonella törzset tudtak izolálni és ezek 30 szerotípusba tartoztak.

A szerzők ábrákon és táblázatokon mutatják be Csongrád megye felszíni vizeinek salmonella fertőzöttségét, valamint az izolált salmonella szerotípusok térbeli és időbeli megoszlását.

Nalaz bakterija Salmonella u površinskim vodama županije Csongrád

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Abstract

Autori su u toku 1976—1977. godine, uglavnom u mesečnim intervalima, izvršili odredjivanje obligatnih i fakultativnih idikatora fekalnog zagadjenja u površinskim vodama županije Csongrád. U ovom radu se iznose rezultati istraživanja samo na zagadjenost Salmonellom reke Tise i njenih pritoka.

Od juna 1976. do dec. 1977. je pripremljeno 317 proba u cilju ispitivanja na Salmonellu. U 1976. god. izolovano je 173 Salmonella tipa koji spadaju u 26 serotipa a u 1977. godini, izolovano je 295 Salmonella tipa pripadnika 30 serotipa.

Autori zagadjenost površinskih voda Salmonellom, kao i njihovu vremensku i prostornu distribuciju ilustruju crtežima i tabelama.

Распространённость бактерий Salmanella в поверхностных водах области Чонград

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В 1976—1977 гг. в основном периодически раз в месяц авторами проводилось определение содержания обязательных и факультативных индикаторных бактерий faecal

Настоящее сообщение даёт информацию лишь относительно засорённостью (поражённостью)

С июля 1976 г. по декабрь 1977 г. было проведено обогащение 317 водных проб с целью анализа *Salmonella*.

В 1976 г. изолировали 173 группы *Salmanella*, из которых 26 относились к серотипу.

В 1977 г. было выделено 295 групп *Salmanella*, из которых 30 относились к серотипу.

Авторы демонстрируют заражённость поверхностных вод *Salmanella* с помощью таблиц и рисунков, а также приводят деление изолированных серотипов *Salmanella* в зависимости от поверхности и времени.

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ALGOLOGICAL INVESTIGATIONS IN THE DEAD ARMS OF THE RIVER TISZA AT TISZAALPÁR AND TISZAUG

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Abstract

The present paper briefly summarizes the alga flora and vegetation of two dead arms of the Tisza river on the basis of investigations made between 1975–1978. In the two biotops, 258 species or intra-species taxons were found. Beyond the respects of nature conservation, the investigation was prompted mainly by the fact that the two bodies of standing water would have different fates in the future. The smaller one at Tiszaug remains a dead arm utilized as a fishery in the future. The larger one at Tiszaalpár and its wider surroundings will be included by a reservoir of the future Tisza-III barrage where the dammed up water will be utilized for agricultural irrigation and recreation purposes. Hydrobiological-algological aspects of the tasks to be done before building the water reservoir are also discussed.

Introduction

The algological study of the dead arms at Tiszaalpár and Tiszaug villages was made during the years 1975–1978 simultaneously with similar investigations in another dead arm at Lakitelek–Tőserdő (Kiss 1978, 1978a). A research project aimed at different aspects of the natural conditions is in progress in the area, partly in the organization of the Tisza Research Committee. The research work is made necessary mainly by the planned construction of the Tisza–III barrage and the connected water reservoir. As it seems likely that the barrage and the reservoir will significantly alter the natural conditions of the Tisza district north of Csongrád village, studying the present conditions is important also in the respect of nature conservation. The general conclusion that a planified guidance or influence of the prevailing present conditions needs the knowledge of the past, is also valid in this case. This refers to the factors of both the abiotic and biotic environment.

The water system of Tisza is relatively young. The present river has been collecting the waters from the edges of the Plainland for several thousands of years. The slow-flowing Tisza shaped very large bends on the present surface which has been evolved for the Quaternary. Some of these bends have been eliminated by the river itself since the beginning of the Holocene, others were artifically cut off during the second half of the last century in connection with the control of the river. These events resulted in the dead arms arranged on both sides of the river. The dead arm at Tiszaug, on the left bank, was mainly resulted by natural detachment while the ones at Lakitelek–Tőserdő and Tiszaalpár located to the west and south of the

former one, respectively, were formed by artifically cutting through former bends. The dead arms at Tiszaug and Tiszaalpár lie on the relief of deep early Holocene inundation area while the dead arm at Tőserdő, situated between the two former ones, joins an extension of the vast sandland of Kiskunság. Consequently, the latter one is surrounded by a wavy relief and its bed is deeper than that of the former two. These differences make one more reason for having published the account on the investigations at Tőserdő separately (Kiss 1978).

The two dead arms we are dealing with lie on lower places of an early Holocene relief but they are not entirely uniform. As it was mentioned, the relatively small bed of the dead arm at Tiszaug was formed through the natural detachment of a bend more than one thousand years ago while the one at Tiszaalpár was resulted in by the artificial control of the river. Therefore, the small dead arm at Tiszaug shows an advanced stage of alluvial filling in and has no real depths. The dead arm at Tiszaalpár is a huge, U-shaped formation, it is generally deep and mostly retained the original character of the river bed. The former one is barely 2 km long, while the total length of the latter is more than 10 km. First of all, it was this great difference in size why I did not study the two dead arms in equal details. I walked along the whole length of the Tiszaug dead arm while in the case of the other one I studied only a part of the bed near to Tiszaalpár community, i. e. between the old Alpár and Tiszaújfalu villages. This part is still 2 km long at least. As the planned water reservoir will also run along Tiszaalpár community through about a 4 km distance, studying the parts of the present dead arm near to the village seemed to be logical in the respect of nature conservation. At some parts of the area the water became strongly eutrophic because of the large amount of the contaminating organic material.

Studying the dead arm along its total length as well as exploring the natural conditions of the so-called field of Alpár awaits for future work. At least the latter one is indispensible as the future reservoir will also include the field of Alpár till about the distance of Bokros community where the waters of the meadow-land reach the Tisza. According to the preliminary plans, the reservoir will be longer than 10 km and its largest diameter will reach 4,5 km.

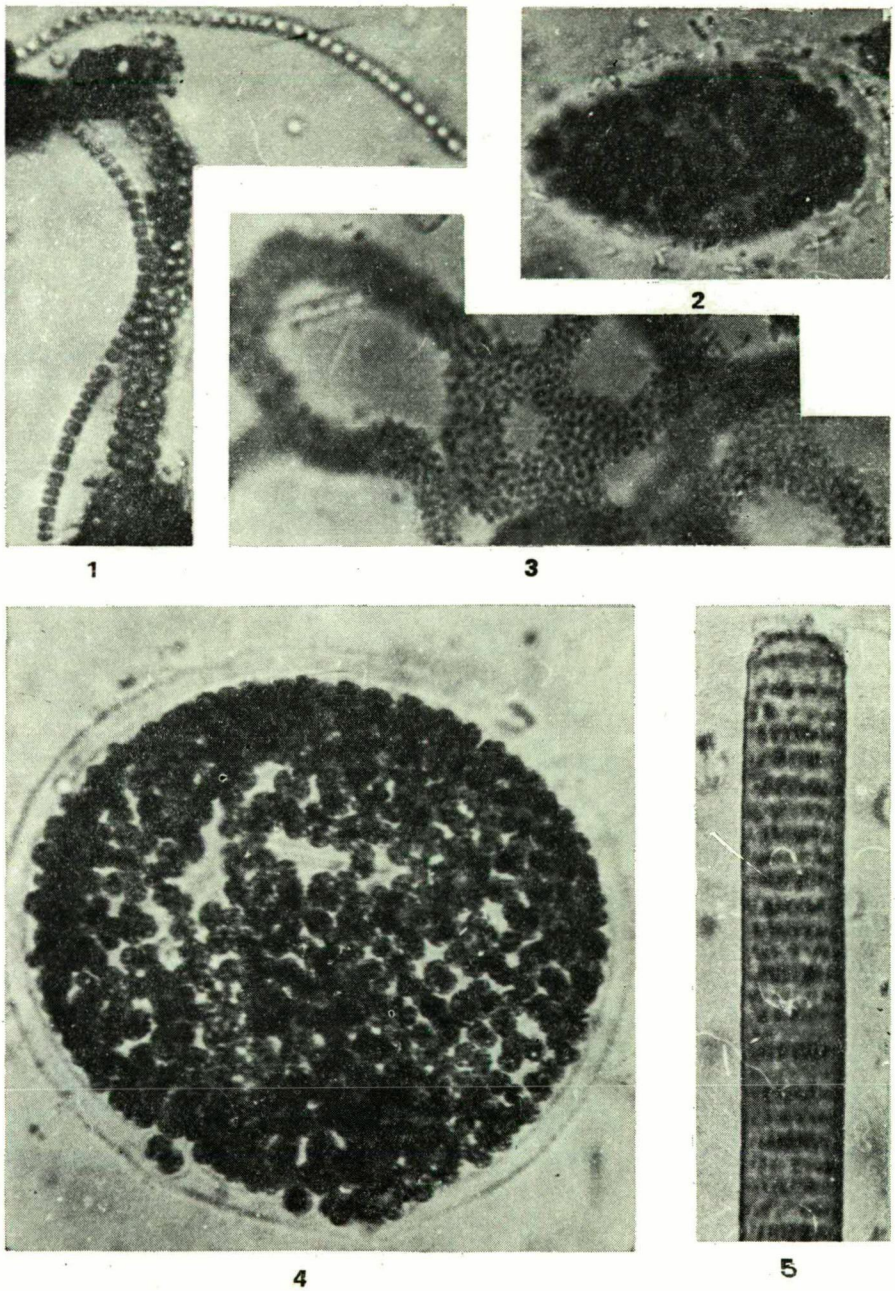
Materials and Methods

Places for water sampling were selected with reference to the ecological conditions. Samples were collected from 4 and 3 places at Tiszaalpár and Tiszaug, respectively, from both the shallow littoral and the deeper pelagic zones. In some of the ladled samples, quantitative determinations were made with the aid of a Bürker chamber. The pH value of the water at Tiszaalpár was between 7.2–7.6. Mostly similar pH values were found also at Tiszaug although in one case (August 4, 1978) pH 8 was measured in the east bend of the dead arm. This could refer to a weak sodification. The alga species were determined in living material and specimens of the more characteristic or rare species were photographed.

Results

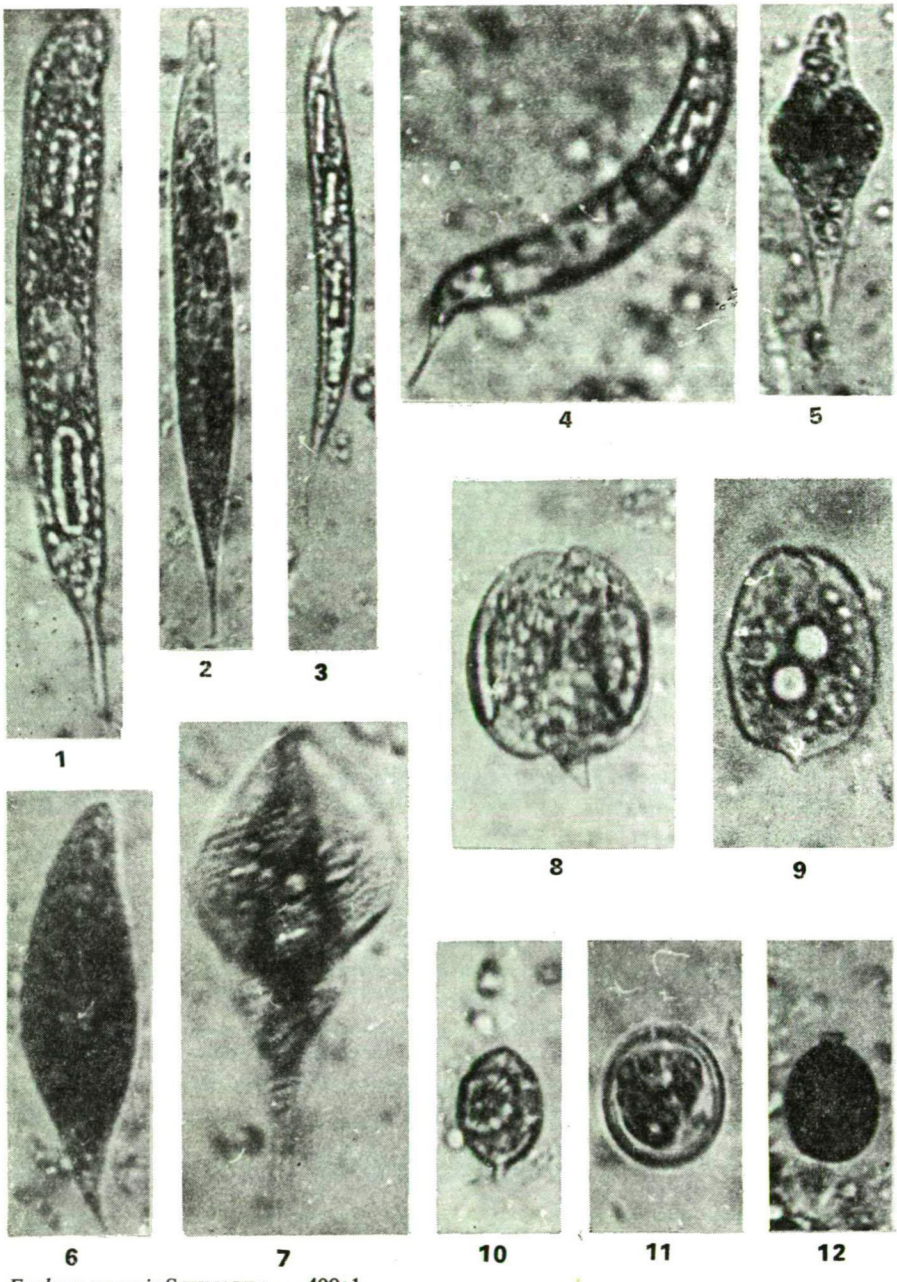
Up to the present, 258 species or sub-specific taxons of algae have been found in the dead arms at Tiszaalpár and Tiszaug. Their distribution according to the phyla is as follows: *Schizomycophyta:* 4, *Cyanophyta:* 69, *Euglenophyta:* 34, *Chrysophyta:* 39, *Pyrrhophyta:* 9, *Chlorophyta:* 103. The *Chlorophyta* phylum is represented by the highest number of taxons but the *Cyanophyta* are also very numerous. The taxons found and the temporary frequencies of their occurance are listed in Table 1 (continued through several pages). We tried to demonstrate their quantitative presence according to the following estimated scale of score-grades:

Plate I



1. *Stigonema spec. (? Stigonema minutum* [AG.] HASS.*)* — 300:1.
2. *Phormidium mucicola* HUBER-PESTALOZZI et NAUMANN — 200:1
3. *Microcystis aeruginosa* f. *pseudofilamentosa* ELENK. — 200:1.
4. *Coelosphaerium dubium* GRUNOW — 750:1.
5. *Oscillatoria maior* VAUCHER — 700:1.

Plate II



1. *Euglena oxyuris* SCHMARDA — 400:1.
2. 3. *Euglena acus* EHRENB. — 2. = 500:1, 3. = 450:1.
4. *Euglena acus* EHRENB. ? forma — 750:1.
5. *Euglena caudata* var. *minor* DEFLANDRE — 750:1.
6. *Euglena proxima* DANGEARD — 800:1.
7. *Phacus helikoides* POCHMANN — 800:1.
8. *Phacus alatus* KLEBS — 1200:1.
9. *Phacus acuminatus* STOKES — 1000:1.
10. *Lepocinclis Lefevrey* CONRAD — 700:1.
11. *Trachelomonas volvocina* EHRENBERG — 1200:1.
12. *Trachelomonas scabra* PLAYFAIR — 800:1.

1 = rare occurance; 2 = sporadic occurance; 3 = frequent occurance; 4 = occurance en mass, development of mass-production.

As it can be seen in Table 1, most of the taxons occurred in both dead arms. From this we can infer that there are no extreme differences in the quality of the water between the two dead arms. However, the quantitative frequencies of the species, the presence or absence of some of them refer to certain differencies in the water quality and, at the same time, show that the requirements of the various species can considerably differ from each other and their tolerance for extreme conditions can also be different. In this respect the following observations are worth to mention:

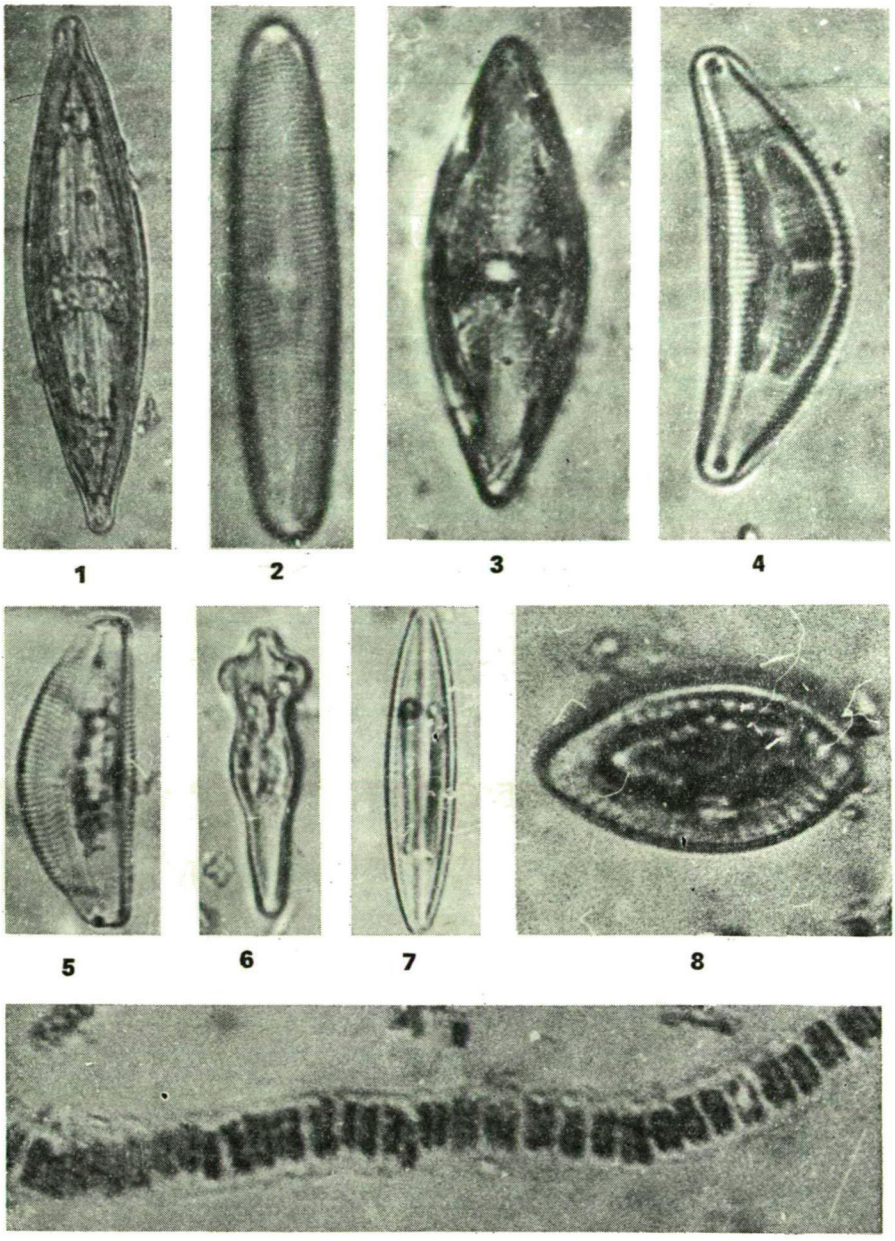
1. Several species were found in all the water samples from both dead arms. It is likely that at least some of them belong to the so-called eurytropic group of species having a really wide tolerance. Such species can be: *Spirulina maior, Euglena acus, Euglena proxima, Phacus pyrum, Trachelomonas volvocina, Trachelomonas scabra, Caloneis amphisbaena, Surirella ovalis, Ankistrodesmus falcatus, Coelastrum microporum, Crucigenia tetrapedia, Scenedesmus acuminatus, Scenedesmus ecornis, Scenedesmus denticulatus, Scenedesmus quadricauda, Pediastrum simplex, Pediastrum tetras.* It is probable, however, that in an experimental test, really extreme conditions would be necessary to recognize the really eurytropic species. The fairly wide tolerance of the above-mentioned 18 species is also supported by the fact that they can occur in strongly alkaline, sodic waters, especially when contaminated with a thin solution of manure components. A deeper, genetic study of this phenomenon would probably lead very far.

2. Some of the species were found exclusively in the water of one or the other dead arms. The following taxons were determined only in samples of the *dead arm at Tiszaalpár: Beggiatoa alba, Gloeocapsa crepidinum, Eucapsis minor, ? Tetrachloris inconstans, Merismopedia punctata, Holopedia Dieteli, Dactylococcopsis Elenkinii, Gloeotrichia Rabenhorstii, Anabaena variabilis, Oscillatoria planctonica, Oscillatoria animalis, Oscillatoria chalybea, Oscillatoria maior, Euglena polymorpha, Lepocinclis ovum, Phacus helikoides, Phacus alatus, Strombomonas verrucosa* var. *conspersa, Strombomonas verrucosa* var. *zmiewika.* The mentioned species comprise a considerable proportion of the total *Cyanophyta* and *Euglenophyta* taxons found. Of the green algae, *Kirchneriella irregularis, Dactylococcus infusionum* and *Tetrastrum triacanthum* were found only in the dead arm at Tiszaalpár while *Tribonema affine, Tribonema minus, Ceratium hirundinella, Peridinium Volzii, Peridinium palatinum, Chlamydomonas intermedia, Ankistrodesmus Braunii* var. *pusilla, Quadrigula Chodatii, Dictyosphaerium pulchellum, Tetrastrum triacanthum* as well as representatives of the *Closterium* and *Cosmarium* species were detected only in the dead arm at Tiszaug. We can not explain the mentioned cases of exclusive occurence, probably many more observations and experimental investigations would be needed for that. In the case of *Closterium* and *Cosmarium* species we can suppose that their exclusive occurence in the dead arm at Tiszaug is a consequence of the cleaner water of this biotop containing much less contaminating organic material. It can be supposed that the really *stenotopic* species having specific needs and narrow tolerance will be found among such taxons of exclusive occurence.

Vegetational forms of the algal flora

The vegetational forms of algae, i.e. the form of their external appearance, can be characterized the best according to their spatial arrangement. They can float in the water space or sit down into some substratum. Of the forms in the water space, the *plankton* was the most frequent causing a vegetational coloration (coloratio

Plate III



1. *Stauroneis parvula* var. *prominula* GRUNOW — 1500:1.
2. *Pinnularia viridis* var. *sudetica* (HILSE) HUSTEDT — 700:1.
3. *Navicula placentula* f. *lanceolata* GRUNOW — 1100:1.
4. *Cymbella cistula* (HEMPRICH) GRUNOW — 600:1.
5. *Cymbella tumida* (BRÉB.) VAN HEURCK — 600:1.
6. *Gomphonema acuminatum* EHRENBERG — 800:1.
7. *Navicula gracilis* EHRENB. — 900:1.
8. *Surirella ovalis* BRÉB. — 750:1.
9. *Hormidiopsis crenulata* (KÜTZING) HEERING — 400:1.

planktogenea) of the water in the case of mass-production *(Euglena polymorpha, Chlamydomonas, Eudorina)*. In rare cases, the phytoplankton mass-productions were transformed into the *phytoneuston* form (coloratio phytoneustogenea). Mass-productions of the filamentous algae appeared in the *lasion* or *pleuston* vegetational forms *(Tribonema, Cladophora, Spirogyra, Mougeotia)*. The coloratio phytoneustogenea mostly coloured the water space beneath the surface, too, and appeared only in very rare cases concentrated on the surface (water bloom, flos aquae). Mass-productions causing vegetational colouration sometimes developed on the surface of the soil, e.g. in the drying up littoral zone (flos humi). Sometimes a picturesque sight was offered by the coloration caused by algal mass-productions on the wall of the dead arm at Tiszaalpár, near to the old Alpár village. In some cases the greenish or bluish-black colour appeared in spots or stripes ranging to several meters on the nearly perpendicular surface of 6–8 m high river wall. The vital wetness was provided by the water running down from time to time from the edge of the wall. The most abundant constituents of these mass-productions were species of the phylum *Cyanophyta*. Old farmers told me also here that a sudden, temporary intensification of the colour of these spots and stripes notifies rain or rainy weather in advance. The meteoro-biological basis of this phenomenon will be discussed elsewhere.

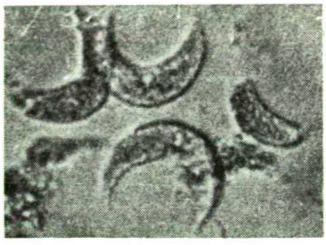
A detailed characterization of the individual alga species can not be given here because of the lack of space. The new taxons will be described elsewhere. The aim of the present investigation was a primary summing-up of the algal flora with special respect to the problems connected to the establishment of the future reservoir. At any rate, the 258 taxons (species, variatio, forma) found in the two dead arms indicate a rich alga flora. In the list of the taxons found, there is a question-mark *before* the name of the algae if the determination was uncertain; a question-mark *behind* the name indicates a loose determination.

Discussion

The two dead arms at Tiszaalpár and Tiszaug will have different fates in the future. The former one becomes an important part of a huge reservoir; the latter remains a dead arm and makes a comparison possible between the emerging new alga population of the reservoir and that of the dead arm at Tiszaug, the latter retaining many of its old characteristics. In such a comparison, however, we have to take into account that the dead arm at Tiszaug not only will go on with the process of siltation but will be more and more utilized for fishing purposes in the future. Although this type of its developing has already begun, no regular dunging is made and so it will not become excessively eutrophic even in years from now. The future reservoir will include the dead arm at Tiszaalpár, the field and meadow of Alpár and the non-protected southern part of the dead arm at Lakitelek–Tőserdő, and will be utilized at least for two purposes. On one hand, it provides water for the agricultural irrigation e.g. in the "Tiszazug" district; on the other hand, it can develop into the centre of a recreation area. The first traces of this can already be noticed near to Tiszaújfalu (fused with the old Alpár community). The latter direction of development, however, necessarily needs an increased protection of the natural environment. At the present the sewage water is directly channeled into the dead arm. In the future, not only this has to be ceased but the purification of sewage water from both the enlarged community and the recreational area has to be solved.

Still before beginning the building operations, a major scientific task will be studying the field and meadow of Alpár in the hydrological, geological-pedological,

Plate IV



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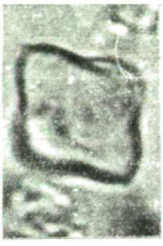

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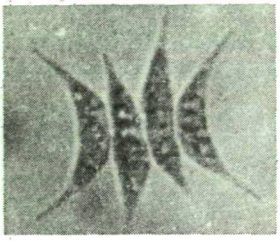

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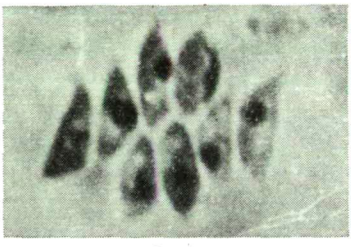

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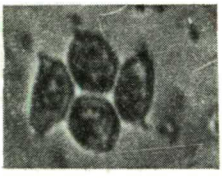

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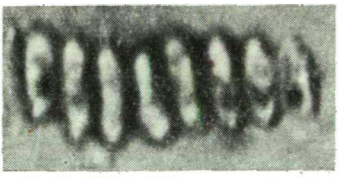

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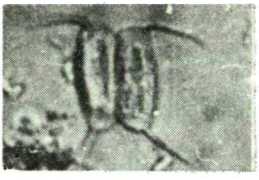

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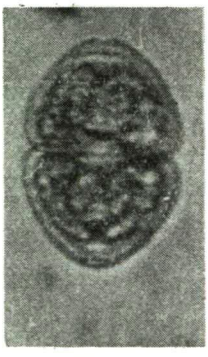

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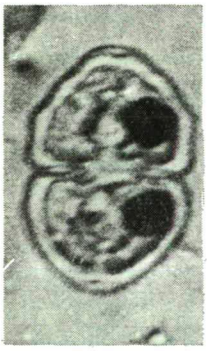

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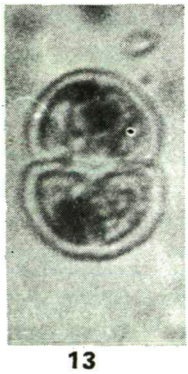

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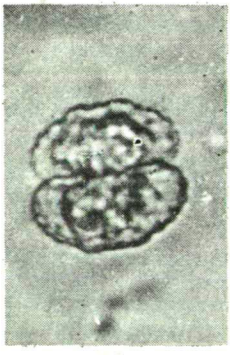

14

as well as hydrobiological and algological points of view. In the lower parts of the meadow, especially near to the dead arms or on the areas between them, there are ponds in which the water stagnates. On the field of Alpár to the east of Bokros community, merge the water-courses coming from the northwest, then they turn to the east and lead a part of the water of the meadow into the Tisza. These ponds and water-courses have a rich alga vegetation which can significantly influence the development of the alga flora of the future reservoir. A better knowledge of them can help to keep the alga vegetation and, through this, the whole living population of the reservoir in the desired equilibrium.

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◄ Plate IV

1. *Selenastrum Bibraianum* REINSCH — 600:1.
2. *Tetraedron proteiforme* (TURN.) BRUNNTHALER — 400:1.
3. *Tetraedron minimum* var. *srobiculatum* LAGERHEIM — 1200:1.
4. *Tetraedron minimum* (A. BRAUN) HANSGIRG — 1000:1.
5. *Scenedesmus acuminatus* (LAGERHEIM) CHODAT — 900:1.
6. *Scenedesmus acutus* f. *costulatus* (CHODAT) UHERKOVICH — 1200:1.
7. *Scenedesmus denticulatus* var. *linearis* HANSGIRG — 1000:1.
8. *Scenedesmus denticulatus* LAGERHEIM — 500:1.
9. *Scenedesmus acutus* f. *semiellipticus* UHERKOVICH — 1200:1.
10. *Scenedesmus quadricauda* var. *quadrispina* f. *gracillimum* UHERK. — 1000:1.
11. *Cosmarium granatum* BRÉBISSON — 1000:1.
12. *Cosmarium granatum* BRÉB. f. *monstruosa ?* — 1200:1.
13. *Cosmarium rectangulare* GRUNOW — 700:1.
14. *Cosmarium commisurale* var. *crassum* NORDSTEDT — 1000:1.

Table 1

No	Species (taxon)	Tiszaalpár					Tiszaug			
		1975	1976		1977	1978	1975	1976	1977	1978
		15 VI	29 IX	3 XI	18 II	5 VIII	15 VI	29 IX	18 II	4 VIII
	Phylum (divisio): *Schizomycophyta*									
1.	*Spirillum undula* EHR.	3	2			2		2		
2.	*Beggiatoa alba* (VAUCH.) TREV.		3	2						
3.	*Beggiatoa leptomitiformis* (MENEGH.) TREV.	2	1					2		
4.	*Spirochaeta plicatilis* EHR.	2	2				3	2		
	Phylum (divisio): *Cyanophyta*									
5.	*Microcystis aeruginosa* f. *pseudofilamentosa* (CROW) ELENK. (Plate I. 3.)	3	3	3				2		
6.	*M. ichthyoblabe* KÜTZ.	1	3							2
7.	*M. ? viridis* (A. BRAUN) LEMM.	2		1	3		2			
8.	*M. delicatissima* (W. et G. S. WEST) STARMACH	2	3				2			
9.	*M. incerta* (LEMM.) STARMACH	3						3		
10.	*Gloeocapsa crepidinum* THURET	2		2						
11.	*G. turgida* (KÜTZ.) HOLLERBACH		2						2	
12.	*Eucapsis minor* (SKUJA) HOLLERBACH				2					
13.	*Coelosphaerium dubium* GRUN. (Plate I. 4)	3				1		2		1
14.	*C. anomalum* (BENNET) DE TONI et LEVI		2				1		1	
15.	*C. Kuetzingianum* NAEGELI		2			3		2		
16.	*Gomphosphaeria aponina* KÜTZ.	3	3	3				2		
17.	*G. Naegeliana* (UNGER) LEMM.	2					2		1	
18.	*Pseudocapsa dubia* ERGEROVIC		2							2
19.	*? Tetrachloris inconstans* PASCHER				3					
20.	*Pelogloea bacillifera* LAUTERBORN			1					2	
21.	*Chamaesiphon confervicola* A. BRAUN				2			2		
22.	*Ch. incrustans* GRUNOW			2					2	
23.	*? Cyanophanon mirabile* GEITLER	1					2			
24.	*Hydrococcus rivularis* (KÜTZ.) MENEGH.			3	3			3	3	

No	Species (taxon)	Tiszaalpár					Tiszaug			
		1975	1976		1977	1978	1975	1976	1977	1978
		15 VI	29 IX	3 XI	18 II	5 VIII	15 VI	29 IX	18 II	4 VIII
25.	*Xenococcus minimus* GEITLER		2						2	2
26.	*Merismopedia punctata* MEYEN		3		1					
27.	*M. glauca* (EHR.) NAEG.			2			2		3	
28.	*Holopedia Dieteli* (RICHT.) MIG.	2				2				
29.	*Dactylococcopsis raphidioides* HANSG.	1	2	2	2	2		3	1	
30.	*D. Elenkinii* ROLL.			2	2					
31.	*D. acicularis* LEMMERMANN		1				1	2		
32.	*Tetrapedia Reinschiana* ARCHER		1					1	2	
33.	*Stigonema spec.* (*St. minutum?* Plate I. 1.)			1				3	1	
34.	*Calothrix stellaris* BORNET et FLAH.			2					2	
35.	*C. parietina* (NÄG.) THURET		1				2	1		
36.	*Gloeotrichia Rabenhorstii* BORN.		2	2						
37.	*G. natans* (HEDW.) RABENH.	3			2			1		
38.	*Rivularia dura* ROTH			1						2
39.	*Nodularia spumigena* MERTENS					2		3	1	
40.	*N. spumigena* var *litorea* (THUR.) BORN et FLAH.		2				2	2		
41.	*Aphanizomenon flos aquae* (L.) RALFS			1			2	2		
42.	*Anabaena variabilis* KÜTZ.	2	1	2	1					
43.	*A. catenula* (KÜTZ.) BORN. et FLAH.		2						2	2
44.	*A. spiroides* KLEBAHN					2	3			
45.	*Anabaenopsis Arnoldii* APTEKARJ		2	3				2		2
46.	*A. Elenkinii* MILLER	2		1		1			1	2
47	*Remeria leopoliensis* (RACIB.) KOCZW.				1		2			
48.	*R. gracilis* KOCZWARA	3		2		2		1		
49.	*Spirulina maior* KÜTZ.	1	3	2	2	1	1	1	1	1
50.	*Sp. laxissima* KÜTZ.	2		2			3		2	2
51.	*Oscillatoria planctonica* Wolosz.		1	1						
52.	*O. Boryana* (Agardh) Bory				1			2		
53.	*O. animalis* AGARDH.	2			2					
54.	*O. laetevirens* (CROUAN) GOMONT		2						1	1
55.	*O. chalybea* MERTENS			1		2				
56.	*O. formosa* BORY	2					2			

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		1975	1976		1977	1978	1975	1976	1977	1978
		15 VI	29 IX	3 XI	18 II	5 VIII	15 VI	29 IX	18 II	4 VIII
57.	*O. simplicissima* GOMONT		2	3	3				3	2
58.	*O. tenuis* AGARDH		1	2	2		2	2		2
59.	*O. maior* VAUCHER (Plate I. 5)	2	3	2						
60.	*O. brevis* (KÜTZ.) GOMONT			3	2			2		
61.	*O. simplicissima* GOMONT	3	1		1		2			
62.	*Phormidium purpurascens* (KÜTZ.) GOM.			1				3	2	
63.	*Ph. ambiguum* GOMONT			3					1	
64.	*Ph. favosum* (BORY) GOMONT		2					1		
65.	*Ph. mucicola* HUBER-PEST. et NAUMANN (Plate. I. 2)			2	1			3	3	
66.	*Ph. tenue* (MENEGH.) GOMONT			2				1		
67.	*Ph. papyraceum* (AGARDH) GOMONT		1					2		2
68.	*Ph. corium* (AG.) GOMONT		2		1					2
69.	*Lyngbya limnetica* LEMM.	3	1	3			2	2		2
70.	*L. Martensiana* MENEGH.	3	3			1	2	3	1	1
71.	*L. stagnina* KÜTZ.		2					1		
72.	*L. spiralis* GEITLER			1			2			2
73.	*Schizothrix polytrichoides* FRITSCH	2	1				3	3	2	2
	Phylum (divisio): *Euglenophyta*									
74.	*Colacium simplex* HUBER-PEST.	2	2				3			
75.	*Klebsiella spec (?)*		1					1		
76.	*Euglena acus* EHRENB. (Plate II. 2–4)	2	2	1	2	2	1	2	2	2
77.	*E. chlamydophora* MAINX			2				1		
78.	*E. gracilis* KLEBS	2	2				2			
79.	*E. limnophila* LEMM.			2				1		
80.	*E. velata* KLEBS		1				3			
81.	*E. proxima* DANG. (Plate II. 6)	2	3	2	1	2	2	1	1	1
82.	*E. tripteris* (DUJ.) KLEBS			2				2		
83.	*E. oxyuris* SCHMARDA (Plate II. 1)	2	2	3		2		2	1	
84.	*E. caudata* var. *minor* DEFLANDRE (Plate II. 5)		3	3				1		
85.	*E. polymorpha* DANG	2	3	4	2	4				
86.	*Lepocinclis Lefevrey* CONRAD (Plate II. 10)	2	2	1	1	2		1		
87.	*L. ovum* (Ehr.) LEMM.		2	2						
88.	*L. Steinii* LEMM. em. CONRAD	2						2		
89.	*Phacus longicauda* (EHR.) DUJ.	1		2						1

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		1975	1976		1977	1978	1975	1976	1977	1978
		15 VI	29 IX	3 XI	18 II	5 VIII	15 VI	29 IX	18 II	4 VIII
90.	*Ph. helikoides* POCHMANN (Plate II. 7)	2	2		2					
91.	*Ph. alatus* KLEBS (Plate II. 8)	3	3	3	1	1				
92.	*Ph. caudatus* HÜBNER					2		1		
93.	*Ph. acuminatus* STOKES (forma?) (Plate II. 9)			2				2	2	2
94.	*Ph. aenigmaticus* DREZ.	2			2				1	
95.	*Ph. inflexus* (KISSELEW) POCHMANN		2	2				3	2	
96.	*Ph. pyrum* (EHRENB.) STEIN	1	3	3	3	1	1	2	1	2
97.	*Ph. striatus* FRANCÉ		2					1		
98.	*Trachelomonas volvocina* EHRENB. (Plate II. 11)	2	1	3	2	2	1	2	2	2
99.	*Tr. volvocina* var. *derephora* CONR.	1	2	1				1	1	
100.	*Tr. intermedia* DANG.				2			1		
101.	*Tr. crebea* KELLICOTT emend. DEFL.		2	2			1			
102.	*Tr. planctonica* SWIRENKO				2			2		
103.	*Tr. granulata* SWIRENKO		3	2				1		
104.	*Tr. similis* STOKES	2	2					2		
105.	*Tr. scabra* PLAYFAIR (Plate II. 12)	1	1	3	1	1	2	3	2	2
106.	*Strombomonas verrucosa* var. *conspersa* (PASCHER) DEFLANDRE		2	2						
107.	*Str. verrucosa* VAR. *zmiewika* (SWIR.) DEFL.	3	1	1						
	Phylum (divisio):									
	Chrysophyta									
	Xanthophyceae:									
108.	*Chlorobotrys simplex* PASCHER	1						2		
109.	*Ophiocytium capitatum* WOLLE		2				2	1		
110.	*Tribonema affine* G. S. WEST						4		3	3
111.	*T. minus* G. S. WEST								2	
	Chrysophyceae:									
112.	*Chrysococcus biporus* SKUJA		2						2	1
113.	*Kephyrion cylindricum* (LACK.) CONR.	1						2		
114.	*Dinobryon sertularia* EHRENB.			3			3	2	2	2
115.	*D. divergens* IMHOF		2	2				2	1	1
116.	*Ochromonas nasuta* SKWORT.	1						2	2	
117.	*Mallomonas caudata* IWANOFF		1				2			

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		15 VI	29 IX	3 XI	18 II	5 VIII	15 VI	29 IX	18 II	4 VIII
	Bacillariophyceae:									
118.	*Melosira varians* AG.						2			
119.	*Cyclotella Kützingiana* THWAITES		2		2			1	2	2
120.	*Diatoma vulgare* BORY	1						2	1	
121.	*Fragilaria capucina* DESMAZIÉRES			2	2				1	
122.	*Fr. crotonenesis* KITTON			1	1					2
123.	*Asterionella formosa* HASSALL		1					2	2	
124.	*Synedra ulna* var. *spathulifera* GRUNOW	1					2			
125.	*Syn. capitata* EHRENB.				2			2		
126.	*Caloneis amphisbaena* (BORY) CLEVE	1	3	1	1	2	2	3	3	2
127.	*Stauroneis parvula* GRUNOW (Plate III. 1)		1				2	2	2	
128.	*Navicula gracilis* EHR. (Plate III. 7)	2	2		1	2		1		
129.	*N. placentula* f. *lanceolata* GRUN. (Plate III. 3)		3	2		1	3	1	1	2
130.	*Navicula cryptocephala* KÜTZ.	3		2			1	3	3	1
131.	*N. cincta* (EHRENB.) KÜTZ.		3		1	2		1		
132.	*N. lanceolata* (AGARDH) KÜTZING			2				2	2	
133.	*Pinnularia viridis* var. *sudetica* (HILSE) HUSTEDT (Plate III. 2)	2	1				2	1	1	1
134.	*Amphora commutata* GRUNOW			2			1	1		
135.	*Cymbella affinis* KÜTZ.		2				2		2	
136.	*C. cistula* (HEMP.) GRUNOW (Plate III. 4)	2	1	1		2	1	2	1	2
137.	*C. tumida* (BRÉB.) van HEURCK (Plate III. 5)		3	2	2			3	2	2
138.	*C. cymbiformis* (KÜTZ.) VAN HEURCK			1		2	2			
139.	*C. prostrata* (BERKELEY) CLEVE		1					1	1	
140.	*Gomphonema acuminatum* EHRENBERG (Plate III. 6)	1	2		2	1	2			2
141.	*G. augur* EHRENB.		1	1	1			2	1	
142.	*G. constrictum* EHRENB.	1	2	2		2	1	1		
143.	*Rhopalodia gibba* (EHRENB.) O. MÜLL.			1	1			1	2	2
144.	*Nitzschia sigmoidea* (EHR.) W. SMITH	2	3	2	2				1	1

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		15 VI	29 IX	3 XI	18 II	5 VIII	15 VI	29 IX	18 II	4 VIII
145.	*Cymatopleura solea* (BRÉB.) W. SMITH	1	1	1	1	2	2	3	2	2
146.	*Surirella ovalis* BRÉB. (Plate III. 8)	2	3	2	2	3	1	3	1	1
	Phylum (divisio): *Pyrrophyta*									
147.	*Ceratium hirundinella* f. *silesiacum* (SCHROED.) HUBER-PESTALOZZI						2	1		
148.	*Glenodinium edax* SCHILLING		1				1	2		
149.	*Glenodiniopsis uliginosa* (SCHILL.) WOLOSZ.			1			2			
150.	*Peridinium cinctum* (MÜLL.) EHR.	2	2					1	2	1
151.	*P. Volzii* LEMMERMANN						3			
152.	*P. palatinum* LAUTERB.							2	2	2
153.	*P. bipes* f. *globosus* LINDEM.		1				1			
154.	*P. Cunningtonii* LEMM.	1				1		1	1	1
155.	*P. aciculiferum* LEMM.			1			2			
	Phylum (divisio): *Chlorophyta* *Chlorophyceae:*									
156.	*Chlamydomonas Steinii* GOROSCH.		3					2		
157.	*Chl. intermedia* CHODAT						4			
158.	*Chl. Reinhardii* DANGEARD	4					4			
159.	*Eudorina elegans* EHRENB.	2	3	2	1	1	2	4	2	2
160.	*E. charkoviensis* PASCHER			2				2		
161.	*E. cylindrica* KORSCHIKOW	1					2	2		
162.	*Desmatractum indutum* (GEITLER) PASCHER		1					1		
163.	*Tetraedron muticum* (A. BR.) HANSG.	1	2		2				2	2
164.	*T. trigonum* (NÄG.) HANSG.			3			1			
165.	*T. proteiforme* (TURN.) BRUNNTHALER (Plate IV. 2)		2		1		3		1	1
166.	*T. caudatum* (CORDA) HANSG.	1				1			1	
167.	*T. regulare* KÜTZ.		1				1	1		
168.	*T. minimum* (A. BRAUN) HANSGIRG (Plate IV. 4)	2		1	2	1		3		
169.	*T. minimum* var. *scrobiculatum* LAGERH. (Plate IV. 3)	1		2		2		1		2
170.	*T. pentaedricum* W. et G. S. WEST		2				2			
171.	*Polyedriopsis spinulosa* SCHMIDLE				2		3	1	1	

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172.	*Schroederia setigera* (Schröd.) Lemm.		3				2	2		
173.	*Characium ambiguum* Hermann		3						1	1
174.	*Ch. angustum* A. Braun			2			1			
175.	*Ch. Braunii* Brügg.	1						2		
176.	*Oocystis lacustris* Chodat		2	2					1	
177.	*O. Naegelii* A. Braun	1					3	3		3
178.	*Chodatella citriformis* Snow				1				2	
179.	*Lagerheimia genevensis* Chodat		1							2
180.	*Franceia echidna* (Bohl.) Kors.		2					1		
181.	*? F. ovalis* (Francé) Lemm.			1			2			
182.	*Nephrochlamys subsolitaria* (G. S. West) Kors.	2	1			2		1		
183.	*Kirchneriella obesa* (W. West) Schmidle	3	1	2	2	2	2	2		3
184.	*K. irregularis* (G. M. Sm.) Kors.		2							
185.	*Selenastrum bibraianum* Reinsch (Plate IV. 1)	2		1			3	3		
186.	*S. Westii* G. M. Sm.				2			1		
187.	*Ankistrodesmus falcatus* (Corda) Ralfs	2	1	1	1	1	1	1	1	1
188.	*A. acicularis* (A. Braun) Kors.		2	2				1		
189.	*A. Braunii* var. *pusilla* Printz						2			
190.	*A. angustus* Bern.	1				2	1			1
191.	*Fusola viridis* Snow		2					1		
192.	*Quadrigula Chodatii* (Tan.–Ful.) G. M. Sm.						2			
193.	*Dactylococcus infusionum* Näg.	3								
194.	*Botryococcus Braunii* Kützing		2					3		
195.	*Dictyosphaerium anomalum* Kors.	1					2	1		1
196.	*D. pulchellum* Wood						1	1	1	2
197.	*Didymocystis bicellularis* (Chod.) Komárek		1			1		1	1	1
198.	*Coelastrum microporum* Näg.	1	1	3	1	1	1	2	2	2
199.	*C. sphaericum* Näg.		1				2			1
200.	*C. sphaericum* var. *punctatum* Lagh.	1						1		
201.	*Crucigenia rectangularis* (Näg.) Gay.		3			1	2	1	1	1

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		15 VI	29 IX	3 XI	18 II	5 VIII	15 VI	29 IX	18 II	4 VIII
202.	*Cr. tetrapédia* (KIRCHN.) W. et G. S. WEST	1	1	3	1	2	1	2	1	1
203.	*Cr. apiculata* (LEMM.) SCHMIDLE		2		2	2	3		1	1
204.	*Cr. quadrata* MORREN	2	1			1	2	2	2	2
205.	*Tetrastrum staurogeniaeforme* (SCHRÖD.) LEMM.			2	1		1	2	2	2
206.	*T. heteracanthum* (NORDST.) CHODAT	2	1	1			2	1		
207.	*T. triacanthum* KORS.							2		
208.	*T. glabrum* (ROLL) AHLSTR. et TIFF.			2		2			1	2
209.	*? Hofmania lunatum* THOMPSON	1			1			1		
210.	*Scenedesmus acutus* MEYEN		3		2		2	2	2	1
211.	*Sc. acutus* f. *costulatus* (CHOD.) UHERK. (Plate IV. 6)	2	1	1		1		3		
212.	*Sc. acutus* f. *semiellipticus* UHERK. (Plate IV. 9)	1					2		1	
213.	*Sc. dactylococcopsis* CHODAT			3				2		
214.	*Sc. securiformis* PLAYFAIR		1				2	2	2	
215.	*Sc. acuminatus* (LAGERHEIM) CHODAT (Plate IV. 5)	1	1	1	1	2	2	3	1	1
216.	*Sc. acuminatus* var. *Bernardii* (G. SMITH.) DEDUSS.	1	1				1	1		
217.	*Sc. acuminatus* var. *elongatus* G. M. SMITH			1				3		1
218.	*Sc. ecornis* (RALFS) CHODAT	2	1	2	1	1	3	1	1	1
219.	*Sc. ecornis* var. *disciformis* CHOD.		1				2	2		
220.	*Sc. ovalternus* CHODAT	1						2		
221.	*Sc. tibiscensis* UHERKOV.			2						1
222.	*Sc. brevispina* (G. M. SMITH) CHOD.	1						2		1
223.	*Sc. denticulatus* LAGH. (Plate IV. 8)	1	3	2	1	1	2	1	1	1
224.	*Sc. denticulatus* var. *linearis* HANSG. (Plate IV. 7)		1	1				1		
225.	*Sc. dispar* BRÉB.	1						2		
226.	*Sc. quadricauda* (TURP.) BRÉB.	2	1	2	1	3	2	1	1	2
227.	*Sc. quadricauda* var. *quadrispina* f. *gracillimus* UHERK. (Plate IV. 10)		2				1	2		
228.	*Sc. quadricauda* var. *biornatus* KISS I.		1				1	2		
229.	*Sc. bicaudatus* (HANSG.) CHODAT		1	2						1

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230.	*Sc. bicaudatus* var. *brevicaudatus* HORTOB.	1		1	1			1	1	1
231.	*Sc. arcuatus* f. *spinosus* HORTOB. et NÉMETH		2	1					1	
232.	*Sc. ellipsoideus* var. *bicaudatus* HORTOB. et NÉMETH		1					2		
233.	*Actinastrum Hantzschii* LAGERH.	2	2	1			3	3	1	1
234.	*A. Hantzschii* var. *gracile* ROLL						2	1	2	2
235.	*Pediastrum simplex* MEYEN	3	2	2	1	1	2	3	1	2
236.	*P. simplex* var. *clathratum* (SCHROETER) CHODAT	1					1	1		
237.	*P. tetras* (EHRENB.) RALFS	1	1	1	1	2	1	1	1	2
238.	*P. tetras* var. *tetraodon* (CORDA) RABENH.		1			1	1	1		
239.	*P. Boryanum* (TURP.) MENEGH.	2	2					2		2
240.	*P. Boryanum* var. *brevicorne* A. BRAUN		1				1			
241.	*P. duplex* MEYEN	1	1	1		2	1	2		1
242.	*Hormidiopsis crenulata* (KÜTZ.) HEER. (Plate III. 12)	2	3			1	2	2	1	2
243.	*Hormidium flaccidum* A. BRAUN				4			2		
244.	*Stigeoclonium tenue* KÜTZING			3				3		
245.	*St. longipilum* KÜTZING	2				2		3		
246.	*Oedogonium* spec.		3				3			
247.	*Cladophora fracta* KÜTZ. ampl. BRAND	4	4	3			4	4		
	Conjugatophyceae:									
248.	*Closterium moniliferum* (BORY) EHR.						2			2
249.	*C. acerosum* (SCHRANK) EHR.						1	2		
250.	*C. Kützingii* BRÉB.						1			
251.	*Cosmarium granatum* BRÉB. (Plate IV. 11)						1	2		2
252.	*C. granatum* BRÉB. f. *monstruosa?* (Plate IV. 12)							1		
253.	*Cosmarium rectangulare* GRUN. (Plate IV. 13)							2		
254.	*C. commissurale var. crassum* NORDST. (Plate IV. 14)						2	1		
255.	*Spirogyra areolata* LAGERH.	4			3		4	4		
256.	*Sp. varians* (KÜTZ.) CZURDA		2				3		3	
257.	*Mougeotia sphaerocarpa* WOLLE	4						3		
258.	M. *angusta* HASSAL	2					2	3		

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A Tisza folyó tiszaalpári és tiszaugi holtágainak algológiai vizsgálata

KISS I.
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Kivonat

Az értekezésben a Tisza folyó két holtágának algaflórája és algavegetációja kerül rövid ismertetésre az 1975—1978 években végzett vizsgálatok alapján. A két biotopból összesen 258 species vagy speciesen belüli taxon került elő. A vizsgálatok végzését a környezetvédelmi szempontokon túl főként az indokolta, hogy e két állóvíz sorsa a jövőben eltérően alakul. A kisebbik továbbra is holtág marad, mindinkább halászati hasznosításra kerül, a nagyobbik holtág és tágabb környezete viszont a jövőben megépítendő Tisza-III Vízlépcső víztározójának területére esik. A felduzzasztott víz mezőgazdasági területek öntözésére és üdülési célokra hasznosul. A munka hidrobiológiai-algológiai vonatkozásban megemlíti azokat a teendőket is, amelyek a víztározó építését megelőzik.

Algološka ispitivanja mrtvaja Tise kod Tiszaalpár-a i Tiszaug-a

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Abstract

U radu je, na osnovu ispitivanja u periodu 1975—1978. god., dat kratak prikaz algoflore algovegetacije sa dve mrtvaje Tise. Sa oba biotopa prikupljeno je ukupno 258 vrsta ili taksona unutar vrsta. Opravdanost ovih ispitivanja, osim zaštite životne sredine, javlja se i u tome što će ove dve stajaće vode u skoroj budućnosti imati različiti status. Manja će i dalje ostati kao mrtvaja i uredić. se u ribnjak, dok će veća mrtvaja sa širom okolinom biti potopljena izgradnjom brane III na Tisi. Voda brane će se koristiti za navodnjavanje i rekreaciju.

Rad u hidrološko-algološkom pogledu ukazuje i na one radnje koje prethode izgradnji brane.

Альгологическое исследование двух мёртвых русел р. Тиса — Тисаалпари и Тисауги

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Резюме

В сообщении приводится информация относительно альгофлоры и альговегетации двух мёртвых русел реки Тисы на основании проведенных в 1975—1978 гг. исследований. Из двух биотопов было выделено 258.

Помимо соображений защиты окружающей среды, проведение данных исследований обусловлено в первую очередь тем, что в дальнейшем сугьба этих двух стоячих вод будет различна. Меньшая и дальше останется мёртвым руслом, которое будет использоваться для целей рыбоводства, большее же мёртвое русло вместе с прилегающей к нему местностью относится к территории, где будет сооружено водохранилище каскада Тиса-III. Запруженная вода используется для орошения сельскохозяйственных областей, а такжде ля секурортных целей. В гидробиологическом и альгологическом аспекте работа подчёркивает те мероприятия, которые должны предшествовать сооружению водохранилища.

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SELTENE STROMBOMONAS—ARTEN AUS DEN TOTEN ARMEN DER TISZA (THEISS) AM MITTLEREN UND OBEREN FLUSSLAUF

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Auszug

In der Abhandlung werden einige selten vorkommende *Strombomonas*-Spezies aus den Toten Armen der mittleren und oberen Theissregion in Ungarn mitgeteilt. Die Mikrophotogramme beweisen, dass die von DEFLANDRE und anderen Autoren festgestellten Speziescharakteristika tatsächlich existieren und zur Trennung der einzelnen taxonomischen Qualitäten auf morphologischer Grundlage geeignet sind. Erörtert wird auch die von DEFLANDRE mitgeteilte Derivierung und gedankliche Ableitung der konturlichen Loricatypen der Spezies. Diesbezüglich gibt der Verfasser auch seine eigenen Untersuchungen und Erfahrungen bekannt.

Einleitung

In den letzten Jahren habe ich beim Studium der Algenflora der Toten Theiss-Arme im mittleren und oberen Flussgebiet in Ungarn selten vorkommende Strombomonas-Arten gefunden, darunter auch solche, die meines Wissens aus Ungarn noch nicht bekannt sind. Ihre Plublizierung ist aber besonders deshalb lohnend, weil sie beweisen, dass die Lorica (Panzerung oder Kapsel bzw. Hülle) als Ausscheidungsprodukt der Zelle nur innerhalb gewisser Grenzen variiert, die Hauptzüge ihrer Kontur, die Charakteristika ihrer Struktur aber gut erkennbar bewahrt.

Zu Beginn meiner Forschungen, von 1930 an, hatte ich von den *Strombomonas*- und *Trachelomonas*-Arten farbige Zeichnungen und Aquarelle angefertigt. Damals wurden in Richtung der Algologen auch Meinungen laut, wonach „... Zeichnen lässt sich vieles, von Algen sollten Mikrophotos angefertigt werden". Diese Meinung war voreingenommen. Zweifellos verdienen die seltenen Organismen auch photographiert zu werden. Hier bringe ich aber besonders deshalb einige Photos von ihnen, weil diese unzweifelhaft beweisen, dass die von ihrem unlängst verstorbenen berühmten Forscher festgestellten Charakteristika wirklich real sind.

Material und Methode

Auch *Strombomonas*-Arten enthaltende Biosestonproben habe ich aus den Toten Armen der folgenden Gemeinden an der Theiss gesammelt: Cibakháza, Tiszaalpár, Tiszaug, Rakamaz, Sárospatak—Végardó, Tiszaluc, Tiszadob, sowie aus einer Vertiefung am offenen Inundationsraum des Sajó bei Putnok. Die in den geschöpften Wasserproben befindlichen Organismen wurden möglichst in lebendem Zustand untersucht. Der pH-Wert des Wassers betrug 7,2 –7,6; lediglich in der Mulde des offenen Innundationsraumes des Sajó mass ich pH 8. Die dortigen Bewohner sprachen auch von einer „Vernatronisierung".

Ergebnisse

Im folgenden charakterisiere ich die Spezies in ihrer an Tabelle I. angegebenen Reihenfolge und werde auch jene Überlegungen erwähnen, die DEFLANDRE hinsichtlich der Verwandtschaftsverhältnisse mitgeteilt hat (DEFLANDRE, 1930).

1. *Strombomonas verrucosa* var. *zmiewika* (SWIR.) DEFL. (Tafel I. 1)

Die trapezoidische Lorica verschmälert sich an ihrem vorderen Pol plötzlich zu einem Hals, der hintere Pol endet in einem kurzen Fortsatz. Die Wand ist gelblichgrau oder bräunlich, ihre Oberfläche in jedem Fall schollig. Diese Variation mit dem kurzen Fortsatz und der scholligen Oberfläche unterscheidet sich vom Typ der Spezies. Grösse: 25–40×17–22 µm. Das Flagellum ist 2–3 mal so lang wie die Lorica. Bekannt aus Europa und Asien. In Ungarn kam sie in jedem der angeführten Biotope vor. Die ungarischen Individuen sind gedrungener als die in der Literatur beschriebenen.

2. *Strombomonas Schauinslandii* (LEMM.) DEFL. (TAFEL I. 2)

Der Körper der Lorica ist fast kugelförmig, vorn mit einem relativ langen Halsteil, hinten mit kurzem Fortsatz. Die bräunliche Wand hat eine schollige Oberfläche, das Flagellum hat zwei — dreifache Körperlänge. Auf der Erde scheint die Art ziemlich verbreitet; von den untersuchten Biotopen in Ungarn kam sie nur aus dem Toten Arm bei Sárospatak–Végardó zum Vorschein. Meines Wissens bedeutet sie für Ungarn ein Novum. Grösse: 20–25×12–15 µm, kleiner als in der Literatur angegeben.

3. *Strombomonas rotunda* f. *Hortobagyii* HUBER–PEST. (Tafel I. 3)

Der Vorderteil der elliptischen Lorica endet in einem verhältnismässig langen und breiten Hals und der Hinterteil in einem kurzen Fortsatz. Die Wandung ist gelblichgrau, mitunter bräunlich, kaum wahrnehmbar schollig. Die Chloroplasten sind scheibenförmig, manchmal winklig. Das Flagellum ist zweimal so lang wie der Körper. In Ungarn erstmalig von HORTOBÁGYI aus dem Toten Theissarm „Nagyfa" mitgeteilt (HORTOBÁGYI 1941). Anlässlich meiner Untersuchungen kam sie aus dem Toten Arm bei Cibakháza und Rakamaz zum Vorschein. Grösse der von mir beobachteten Individuen: 20–30×12–17 µm. Nach HUBER–PESTALOZZI ein wenig bekannter Organismus; die Spezies selbst erwähnt er lediglich aus Australien.

4. *Strombomonas gibberosa* var. *longicollis* PLAYF. (Tafel I. 4)

Die Lorica ist in Richtung der Längsachse stark komprimiert, vorn endet sie in einem sehr langen zylindrischen Hals, um am hinteren Pol in einem stark entwickelten Fortsatz zu enden. Der Rand des Halses ist schräg abgeschnitten, manchmal etwas auswärts geneigt. Die Wand ist gelblichbraun und an der Oberfläche von mehr-minder grossen Schollen überdeckt. Die Chloroplasten sind scheibenartig, manchmal eckig und relativ gross. Ein Flagellum sah ich nur bei einem einzigen Individuum; seine Länge stimmte annähernd mit der des Körpers überein. Grösse: 30–40×16–20 µm. Der Hals ist mindestens so lang wie der zusammengedrückte Körper der Lorica und der Fortsatz noch wesentlich länger. Es dürfte sich um einen äusserst seltenen Organismus handeln. HUBER–PESTALOZZI erwähnt ihn nur einmal aus Australien. Während meiner Untersuchungen kam diese Spezies nur aus dem grossen Toten Arm bei Cibakháza — in Ungarn zum ersten Mal — zum Vorschein.

5. *Strombomonas gibberosa* (PLAYF.) DEFL. (Tafel I. 5–6)

Der mittlere Teil der longitudinal stark komprimierten Lorica erinnert an ein Rhomboid, dessen seitliche Spitzen abgerundet sind. Dieser Teil verschmälert sich nach vorn mit konkaver Wölbung zu einem langen Hals. Der Hals ist gerade abgeschnitten, der Rand nach auswärts geneigt und intakt. Der rhomboidartige Loricakörper endet auch nach hinten rückwärts mit langer konkaver Biegung in einen wohl entwickelten Fortsatz. Dies ist eine extreme Loricaform. Grösse: 45–55×28–32 μm (s. Mikrophoto 5). Die Wandung ist gelblich oder entschieden braun, meistens stark schollig, mitunter auch von schuppenartigen flachen Gebilden überzogen. Die Chloroplasten sind scheibenförmig, das Stigma oft gut entwickelt, das Flagellum ist von der gleichen Länge wie der Körper oder anderthalb mal so gross. Diese extreme Körperform fand ich lediglich bei einigen wenigen Exemplaren aus dem Toten Arm bei Tiszaluc.

Die weniger extreme und etwas kleinere Form dieser Spezies veranschaulicht Mikrophoto 6. Die Lorica ist in diesem Fall in Richtung der Längsachse erheblich komprimiert, ihre Seiten aber sind breiter abgerundet. Die Wand ist auch hier gelblichbraun oder braun, doch sind die, die Oberfläche überdeckenden Schollen feiner als bei der vorigen Variation. Der Halsteil ist meistens etwas shräg abgeschnitten und der hintere Fortsatz nicht allzu lang. Die Chloroplasten sind scheibenartig, das Flagellum ist mindestens eineinhalb mal so lang wie der Körper. Grösse: 38–40× 18–22 μm. Diese Form konnte in den Toten Armen bei Tiszaluc und Tiszadob in wenigen Exemplaren beobachtet werden.

Die *Strombomonas gibberosa*-Spezies erwähnt HUBER–PESTALOZZI aus Frankreich, Holland, Mandschurien, Australien und Venezuela. Typischerweise sind die vorwiegend aus Ungern beschriebenen Exemplare jedoch gewöhnlich kleiner.

6. *Strombomonas maxima* (SKVORTZ.) DEFL. (Tafel I. 7)

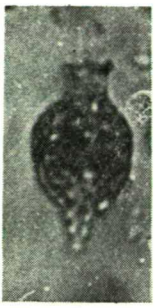
Eine der längsten *Strombomonas*-Arten. Grösse: 70–80×23–30 μm; aber auch so sind sie noch wesentlich kleiner als die in der Literatur mitgeteilten. Nach HUBER–PESTALOZZI erreichen sie eine Grösse von 84–107×34–44 μm (HUBER–PESTALOZZI 1955). Der Mittelteil der spindelförmigen Lorica ist ellipsoid, vorn allmählich zu einem Hals verschmälert, hinten in einem ziemlich langen und meist gewölbten Fortsatz endend. Der Rand des Halsteiles ist unregelmässig gewellt oder unterbrochen. Die Wand ist stets glatt, meistens hyalin, und zwar dermassen, dass darunter auch die Details des Protoplastos durchscheinen. Ihre Farbe ist selten strohgelb. Die Wandung des mittleren Loricaanteils ist — zumindest im juvenilen Alter — noch dermassen plastisch, dass darin die metabolische Bewegung des Protoplastos eine gezogene Längsfurchung oder unregelmässige Gliederung hervorruft. Auch Paramylien sind vorhanden, welche anlässlich der metabolischen Motilität des Protoplastos als sphärisch runde, stark lichtbrechende Körperchen erscheinen. — Ein selten vorkommender Organismus, der nicht nur für Ungarn ein Novum darstellt, sondern laut HUBER–PESTALOZZI auch in Europa unbekannt war. Er erwähnt diesen nur aus Nordmandschurien, Agypten und Venezuela. Ich sammelte sie bei meinen Untersuchungen in grösserer Zahl aus dem grossen Toten Arm bei Cibakháza.

7. *Strombomonas costata* DEFL. (Tafel I. 8)

Die ellipsoide Lorica nimmt bei den entwickelten Individuen meistens rhomboide Gestalt an, da der mittlere Teil beiderseits in ungleichem Masse winklig hervorquillt. Vorn erfolgt allmähliche Verschmälerung zum Hals, der sich aber meistens zylindrisch gestaltet und so an den Kragen der *Trachelomonas* erinnert. Hinten in der

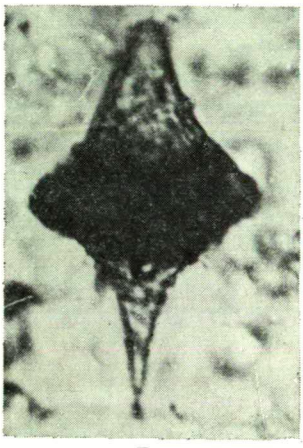
1

2

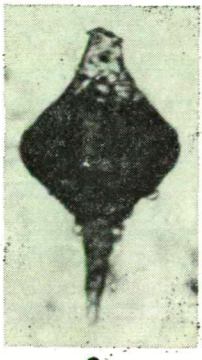


3

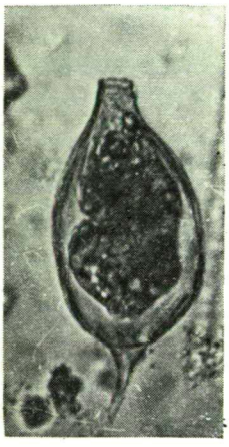
4



5

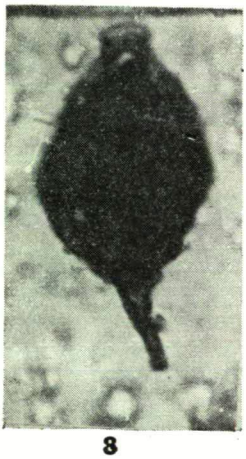


6

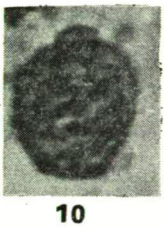


7

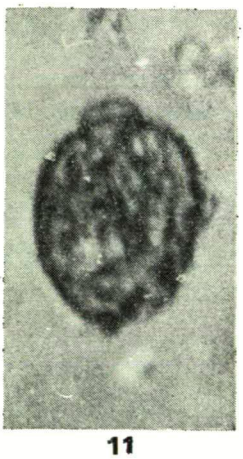
9



8



10



11

Mitte geht sie in einen langen Fortsatz über, der meistens schief und ungleichmässig gekrümmt ist. Der Saum des kragenförmigen Halses ist intakt oder mässig gegliedert. Die Wand hingegen meistens rostbraun und ihre Oberfläche stark schollig, so dass die im Schrifttum erwähnten longitudinal verlaufenden Falten bzw. kanälchenartigen Invaginationen nicht erkennbar waren. Auch hinsichtlich der starken Scholligkeit weicht diese Art von den Charakterisierungen in der Literatur ab. Der Chloroplast ist ohne Pyrenoid, meistens scheibenförmig. Das Flagellum ist etwa von Körperlänge, das Stigma entwickelt. Grösse: 40–50×22–28 μm; also kleiner als in der Literatur angegeben. Bekannt aus Frankfurt und Belgien; von CONRAD aus Salzwasser erwähnt. Bei meinen Untersuchungen konnte ich sie aus zwei Biotopen einholen, nämlich bei Cibakháza und Tiszaluc.

8. *Strombomonas subcurvata* (PROSCHKINA-LAVRENKO) DEFL. (Tafel I. 9)

Der untere Teil der etwas komprimiert-ovalen Lorica ist — wahrscheinlich infolge der leicht spiralgegliederten Wandung — etwas einseitig gedrückt. Vorn ist der Hals kragenartig, geht dann aber allmählich in den Schulterteil des Loricakörpers über, so dass dieser nicht als wirklicher Kragen zu betrachten ist. Hinten zugespitzt meistens einseitig. Die Wand ist hyalin und an der Oberfläche stark schollig. Die Chloroplasten sind scheibenförmig, das Stigma ist entwickelt und das Flagellum ist anderthalb mal so lang wie der Körper. Grösse: 35–40×15–22 μm; kleiner als von PROSCHKINA-LAVRENKO angegeben. Einzig aus dem Toten Arm bei Tiszaluc konnte ich bei meinen Untersuchungen einige Exemplare sammeln.

9. *Übergangs-Organismen unsicherer Zugehörigkeit* (Tafel I. 10–11)

Aus den Wasserproben am oberen Flusslauf fand ich auch einige Organismen, welche eindeutig weder dem *Strombomonas-*, noch dem *Trachelomonas*-Genus zugeordnet werden konnten, und zwar deshalb, weil der Halsteil der Lorica kragenartig ausgebildet ist, was entschieden eine Eigentümlichkeit der *Trachelomonas* ist. Gleichzeitig ist diese Ausbildung nicht ganz eindeutig. An dem Photo 11. ist z. B. einwandfrei ersichtlich, dass auch ein rudimentärer Halsteil enstanden ist und sich aus diesem nachträglich der dünnwandige Kragen herausgebildet hat, der sich als dunkle Linie deutlich sichtbar vom Halsteil absondert. Grösse: 40×25 μm. Die Wand weist entschiedene *Strombomonas*-Struktur auf. Bei dem an Mikrophoto 10 dargestellten Objekt hat sich entschieden ein niedriger Kragen herausgebildet, doch wies die Wandstruktur ebenfalls *Strombomonas*-Charakter auf. Grösse: 30×14 μm. Beide Loricatypen kamen aus dem grossen Toten Arm bei Cibakháza zum Vorschein.

◂ Tafel erklärung

1. *Strombomonas verrucosa* var. *zmiewika* (SWIR.) DEFL. — 800:1.
2. *Strombomonas Schauinslandii* (LEMM.) DEFL. — 1000:1.
3. *Strombomonas rotunda* (PLAYF.) DEFL. *f. Hortobagyii* HUBER—PESTALOZZI — 1000:1.
4. *Strombomonas gibberosa* var. *longicollis* PLAYF. — 1000:1.
5. *Strombomonas gibberosa* (PLAYF.) DEFL. — 1000:1.
6. *Strombomonas gibberosa* (PLAYF.) DEFL. (f. ?) — 1000:1.
7. *Strombomonas maxima* (SKVORTZ.) DEFL. — 600:1.
8. *Strombomonas costata* DEFL. — 1000:1.
9. *Strombomonas subcurvata* (PROSCK.-LAVR.) DEFL. — 700:1.
10. „Übergangsform" zwischen *Trachelomonas* und *Strombomonas* — 600:1.
11. „Übergangsform" zwischen *Strombomonas* und *Trachelomonas* — 750:1.

Die Frage der Verwandtschaftsverhältnisse, Diskussion

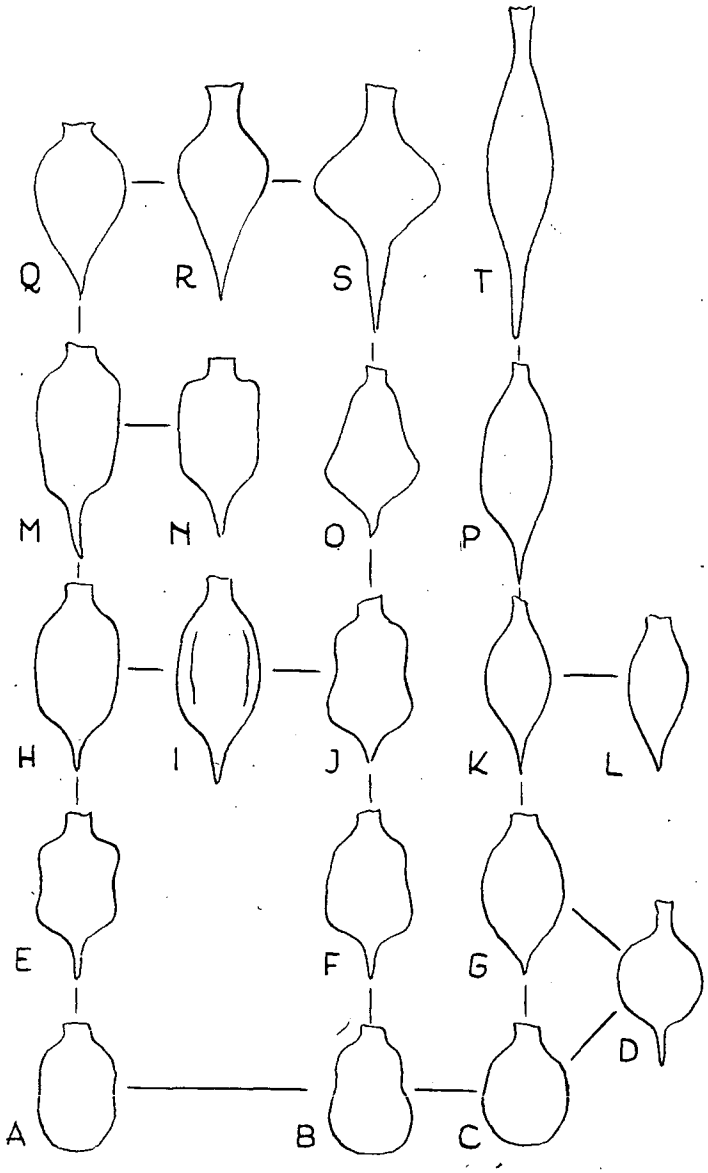
DEFLANDRE demonstriert in seiner den *Strombomonas* nova Genus differenzierenden grundlegenden Arbeit (DEFLANDRE 1930) an einer besonderen Tafel die morphologische Herleitbarkeit der Lorica der Arten (Abb. 1). Die *Strombomonas verrucosa* geht von drei Loricaformen aus, die ganz unten an der Abbildung in der nachstehenden Reihenfolge zu finden sind: *A:* Fast zylindrische, über parallele Seiten verfügende, unten abgerundete Lorica. *B*: Konkavseitige, abwärts verbreiterte und unten abgeflachte, am oberen Teil schmälere Lorica. *C:* Nahezu kugelförmige Lorica. — Diese bilden die unterste Reihe der Abbildung, oberhalb folgt noch die zweite, dritte, vierte und fünfte Reihe. Entsprechend den drei Loricatypen der untersten Reihe unterschied DEFLENDRE drei vertikale Hauptkolumnen und bezeichnete die Spezies mit grossen Lettern. In dem so entstandenen Loricasystem nehmen die aus den Toten Armen der Theiss hier bekanntgegebenen Taxone folgendermassen Platz:

Die *Strombomonas verrucosa* var. *zmiewika* wurde in die zweite Reihe der Kolumne *B* placiert *(E)*. Ebenfalls in Kolumne *B* nimmt in der fünften Reihe *Strombomonas gibberosa (S)* Platz, bei der die Lorica über einen langen Fortsatz verfügt und ungefähr im oberen Drittel stark verbreitert ist. *Strombomonas maxima* fungiert in der vierten Reihe von Kolumne *C (P)* mit in einem Fortsatz endender, äusserst schlanker Lorica. Die *Strombomonas costata* wurde schliesslich in der dritten Reihe in die Nebenkolumne zwischen den Hauptkolumnen *A* und *B* eingereiht (I).

Dieses von DEFLANDRE aufgestellte Formensystem trachtet jene Möglichkeiten und Tendenzen darzustellen, infolge derer sich aus dem unten abgerundeten Loricatyp die unten zugespitzten oder mit einem Fortsatz versehenen Loricatypen entwickelt haben dürften. Dies ist natürlich nur eine Vermutung, eine gedankliche Herleitung, welche teilweise die Wirklichkeit spiegeln mag.

Diese Ableitung kann auf der Grundlage gedankenerweckend sein, dass möglicherweise die hintere Zuspitzung oder der Fortsatz der Lorica — ebenso wie der Halsteil — von der darin befindlichen und metabolische Bewegungen vollziehenden lebenden Zelle („Protoplastos") ausgeschieden wird. Dies könnte so vor sich gehen, dass nach der Teilung die aus der Lorica ins Freie gelangende nackte Zelle mit der Ausscheidung, der „Ausschwitzung" der Grundsubstanz für ihre eigene neue Lorica beginnt, die sie inzwischen mit Hilfe der in apikaler und basaler Richtung erfolgenden metabolischen Auspressung zu formen vermag. Meine Beobachtungen und Züchtungsversuche hatten früher hierauf hingedeutet, vor allem im Prozess der Lorica-Morphogenese der *Trachelomonas*. Das „ausgeschwitzte" halbflüssige Lorica-Grundmaterial ist farblos oder gelblich getönt und schmiegt sich anfangs der Pelliculaoberfläche an. Im Laufe der metabolischen Bewegungen erweitet und formt die Zelle diese Hülle — wahrscheinlich in spezifischer Weise. In Kulturen sah ich, dass die unten vorgewölbten Loricaformen der *Trachelomonas*-Spezies, die sog. *Tumidosa*-formen so zustandekommen, dass die bereits im Erstarren begriffene Loricawand von den metabolische Bewegungen vollziehenden Zellen unten dauerhaft oder mehrfach ausgepresst, geformt wird. Die schon völlig erstarrte Wand kann so auch aufreissen und der Loricafortsatz der *Strombomonas* sogar abbrechen.

Das Motilitäts-„Verhalten" der ihre Lorica entwickelden Zelle: das Herausdrücken, der Grad ihrer Zuspitzung, deren Rhythmus und zeitliche Dauer sind meinen Beobachtungen zufolge ziemlich abweichend. In dem Masse, wie dies — zumindest teilweise — auch genetisch fixiert ist, kann die spezifische, für die Spezies mehr-minder charakteristische Form und Struktur der Lorica der *Trachelomonas* und der *Strombomonas* zur Entstehung gelangen.



Erklärung von Abbildung 1

„Herleitung" der Loricaformen (nach DEFLANDRE).

A, B, C = *Strombomonas verrucosa*, D = *St. praeliaris*, E = *St. Girardiana*, F = *St. verrucosa* var. *zmiewika*, G = *St. ovalis*, H = *St. urceolata*, I = *St. costata*, J = *St. acuminata*, K = *St. fluviatilis*, L = *St. lanceolata*, M = *St. Chodati*, N = *St. triquetra*, O = *St. acuminata* var. *triangulata*, P = *St. maxima*, Q = *St. napiformis*, R = *St. cuneata*, S = *St. gibberosa*, T = *St. australica*.

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Ritka Strombomonas fajok a Közép- és Felső Tiszavidék holtágaiból

KISS I.

József Attila Tudományegyetem Növénytani Tanszék, Szeged

Kivonat

Az értekezésben a magyarországi Közép- és Felső-Tiszavidék holtágainak néhány ritkán előforduló *Strombomonas* speciese kerül ismertetésre. A mikrofotók tanusítják, hogy a DEFLANDRE és más auktorok által megállapított species-jellegek valóban léteznek s alkalmasak az egyes taxonómiai minőségek morfológiai alapon történő elválasztására. Szól a munka a speciesek kontúrbeli loricatípusainak DEFLANDRE által közölt származtatásáról, gondolati levezetéséről is. Ide vonatkozóan szerző saját vizsgálati tapasztalatait is megemliti.

Retke Strombomonas vrste iz mrtvaja srednjeg i gornjg područja reke Tise

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Abstract

U radu se prikazuje nekoliko vrsta *Strombomonas* iz mrtvaja srednjeg i gornjeg područja reke Tise, koje se retko javljaju. Mikrofotografije potvrdjuju da sa strane DEFLANDRE-a i drugih autora utvrdjene odlike vrsta realno postoje, i da su pogodne za determinaciju pojedinih taksonomskih karaktera na osnovu morfoloških odlika. Nadalje u radu se govori još i o teoretskom izvodjenja i filogeniji vrsta na osnovu konturnih odlika lorica-tipova koje je postavio DEFLANDRE. U torm smislu autor, na osnovu sopstvenih ispitivanja, daje i svoja zapažanja.

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REVISION OF THE HOME DISTRIBUTION OF WOLFFIA ARRHIZA (L.)

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(Received 10 September 1978)

Abstract

Our smallest floriferous plant, *Wolffia arrhiza* (L.) HORKEL ex WIMMER 1857, is wide-spread in all flat areas of Europe, till the latitude of 15 north, resp. till the July isothermic line of 18 °C (in North-western Europe: 17 °C) where there is enogh eutrophic standing water, rich in nutritive matters. In countries lying in the north, full of mountains or having a dry climate, it is very rare or is entirely missing.

In our country, its distribution is fairly scattered although it is imaginable that, after a close scrutiny, we may obtain knowledge of much more habitats. It was known earlier only from the middle and south-eastern parts of the territory east of the river Tisza when, in 1972, I found it closed to the community Túrricse in county Szatmár. In the following years, I found more and more localities of it in that region and it proved to live in many places in the flatland of Szatmár-Bereg and even its newer occurrences in large numbers are to be expected.

In this region, it occurs mostly among *Spirodela polyrrhiza, Lemna minor, Salvinia natans, Utricularia vulgaris,* sporadically *Lemna trisulca,* etc. in various, convenient associations. Its ratios related to the enumerated species give in the surveys, on the average, 60 to 80 per cent values (Its characteristics are: A–D=between 3–5, resp. 4–5 (5–5); K= (in every case) V./. It is not rare in pure stands.

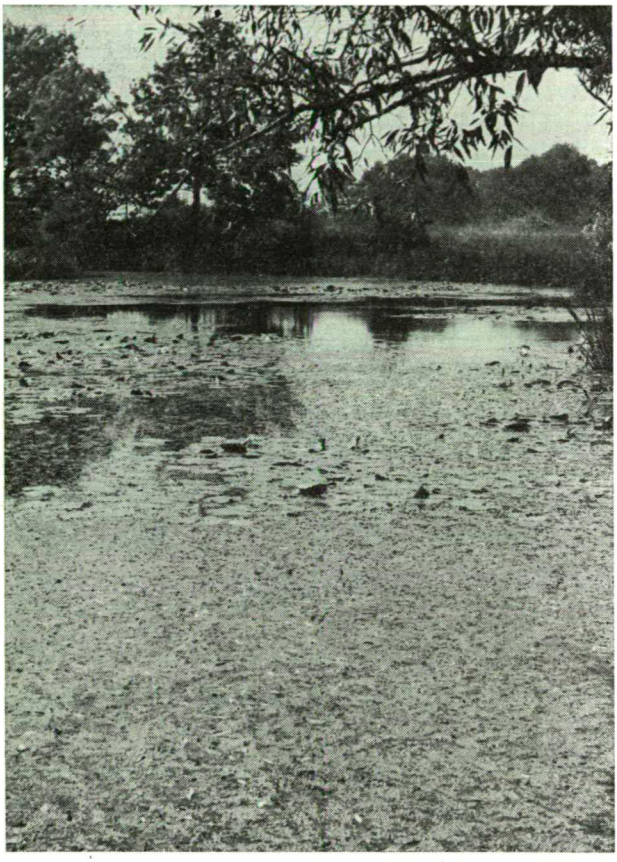
Our knowledge of its ecology, dispersion is sketchy and we are sure of that further investigation of these questions will furnish several more pieces of information.

Its suggested protection also means the necessity of protecting the water habitats. This is equally justified by its being scientifically and economically considerable.

*Wolffia arrhiza (*L. *1771) (=Lemna)* WIMMER *1857,* resp. with righ auctorial name W. *a.* (L.) HORKEL *ex* VIMMER *1857*" (KANDELER 1976) is the smallest floriferous plant. There have so far been few authors all over Europe who dealt with its research, outlining its area exactly. In more neighbouring countries, and even in this country, the investigation into water-plant associations came into prominence only since the latter years. In the course of works like these, about this — in many respects (both in scientific and economic questions equally) considerable but mostly easily lost-plant the collection of a more and more considerable body of knowledge is to be expected. Light is thrown on several biotopes of this plant, not known until now, just recently. In this country, too, it lives in more places than it is known so far in the literature on the subject. And owing to the insufficient attention paid to it, it is not impossible that it was much more frequently occurring before the beginning of the flood defence and reclaiming works. Today we can only try to guess whether its multiplying recent data are really its new appearances or only the present detections of its since very long

hiding occurences. It is imaginable, too, that we only see the ecological changes taking place in extensive areas, spreading of minor stands which survived in some suitable, concealed, remotest corners of the country.

Wolffia is an ecologically indifferent, thermophilous plant. Floating in eutrophic standing waters, rich in nutritive matters, it occurs in large numbers. It is a *Lemnion* character-species, forming associations, respectively it presents itself in the following



Photograph 1. Mill-pond at Csaholc (Photo by I. FINTHA).

plant associations: *Wolffietum arrhizae, Wolffio-Lemnetum gibbae,* and additionally in *Salvinio-Spirodeletum (-polyrrhizae Wolffietosum), Stratiotetum (Hydrochari-Stratiotetum), Ceratophylletum demersi, Ceratophylletum submersi, Lemno-Utricularietum, Myriophyllo-Potametum, Parvopotameto-Zanichellietum,* as well as in reeds *(Scirpo-Phragmitetum, Acoretum)* and, farther from our country, in others, as well (Soó 1973).

It is floristico-phytogeographically a flatland kollin, wide-spread in the eastern hemisphere, in Europe it is an Atlantic-Mediterranean floristic element (Soó 1973) or, according to others, a subtropical one (Asia, Africa, Australia), in Northern Europe it is adventive (BEĆAREVIĆ 1953), resp. cosmopolitan (SOÓ–JÁVORKA 1951). In this country, it is perhaps neophytic (Soó 1973). It spreads by means of water,

wind, water-birds. The migrating water-fowl can carry it on its leg, bill, feathering far away on the pathway of its migration. In this country, it is not propagated by zoogamy. And even, there is only known a single flowering datum of it, from the northern foreground of the Caucasus (BENKOVÁ 1957).

6–8 of the 14–16 species of the genus are only American, 1 species is Central-American, 5 species are only African, 1 species is from Central Asia and 1 species is Eurasian–African–Australian (KANDELER 1976). The latter one *W. arrhiza,* has spread in Europe till the latitude of 55° north. More exactly it lives till the isothermic line where the July mean temperature is 18 °C (resp. in North-Western Europe, as well as in the south-eastern part of the British Isles 17 °C), in 0.75–1.5 m deep waters (KANDELER 1976) (Cf. with the map, too).

It is in Europe mainly the inhabitant of the southern and western flat areas. In the south and on the higher reliefs, in the mountains — owing to its thermophilic nature — it is missing and it can, of course, not be found in the dry provinces, either.

On the territory of Hungary, the water-meal is of fairly sporadic distribution although — because of the incidental form of its research — its exact data are not known. The literature on its home occurrences is small and in some cases it is difficult to be brought to light. In the following, I arrange these in time order and speak among them of the observations not published as yet. At last, I also publish the results of my own investigations.

From among our divers, L. SIMONKAI met it first, detecting it in or about 1880 in Pancsova, in a reservoir (DEGEN 1910). About thirty years thereafter, A. DEGEN found it in the Lake Grobnik in the neighbourhood of Fiume, in his collecting way on 8 August 1910 (DEGEN 1912). For the third time, it was found by E. Unger in the water of the Mosztonga in County Bács–Bodrog, in September 1915 (UNGER 1916).

On the present-day territory of our country, it was described first by Á. BOROS from the Danube-Arm at Soroksár, in 1946. At the same place it had been looked for in vain for years but then it appeared again. L. ALMÁDI observed its occurrence close to Szarvas, in the water of a Körös Dead-Arm in 1958 (VÖRÖSS 1966). This latter is, at the same time, its first datum from beyond the Tisza. Its occurrences here and in the brooklet Korhány in Rumania (POP 1968) are obviously in connection with each other.

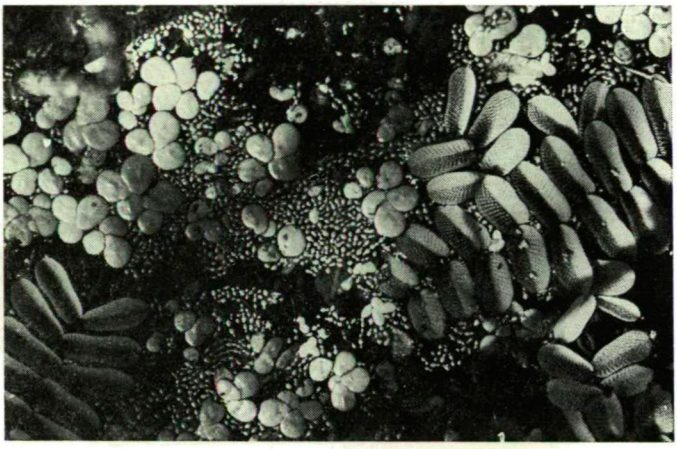
In the Autumn of 1960, and in 1961, it appeared in an immense quantity in the Tisza Dead-Arm, on the confines of the community Oszlár. It has been, as the author writes, to be found since then — with the exception of the full draining of the ox-bow lake in 1962 (TÓTH 1972). In Lake Velence, it was seen by L. TÓTH on the water of a clearing in a reedy marsh, in 1960 (VÖRÖSS 1966).

A newer habitat on the territory east of the Tisza was also been found by S. TÓTH at Tiszaluc, where a stand of lower density lived. (TÓTH 1972).

Among its home occurrences the most important ones are those in Szatmár Bereg. I have first found it in this most eastern region of our country and one of the most northern parts of the Great Hungarian Plain, in 1972, two years after the oversized Tisza–Szamos flood. I found it then in varying amount on the confines of the community Túrricse, in the dead bed of the former brook Túr meandering through the forest of Ricse, in *Lemno-Utricularietum* association. The biotope which is humid through the whole year is surrounded by a very nice hornbeem oak-plantation *(Querco robori-Carpinetum hungaricum)* the remarkable underwood of which is full of montanic species. (Apart from the known occurrences: *Polypodium vulgare, Heracleum Sphondylium, Asarum europaeum, Lathyrus niger, L. vernus, L. Nissolia, Circaea lutetiana, Impatiens noli-tangere, Gentiana pneumonanthe, Symphytum tuberosum,*

Ajuga reptans, Galeopsis speciosa, Lamium Galeobdolon, Paris quadrifolia, Melampyrum nemorosum, Lathraea squamaria, Scilla bifolia, Majanthemum bifolium,, Leucojum vernum, Gladiolus imbricatus, Luzula pilosa, Melica nutans, etc.). It is a fault that the conservation of the area is not solved, as yet.

In the following years, 1973 and 1974, I saw *Wolffia* in many places between Túrricse and Kölcse, but in the largest numbers, anyway, in 1974 in the area of Nagyrekesz, on the confines of Csaholc, full of ox-bow lakes, in the old-time Túr-stretch, made wider for the sake of a water-mill which operated here in olden times. The water surface was covered here and there by its pure stands. It occurred, however, generally in *Salvinio-Spirodeletum polyrrhizae* associations, spreading among the floating groups of *Spirodela polyrrhyza* and *Salvinia natans.*



Photograph 2. *Wolffia* stand in *Salvinio-Spirodeletum (polyrrhizae Wolffietosum).* Csaholc Millpond. (Photo: I. FINTHA)

I know from the oral information of my colleague, I. TÖLGYESI, botanical superviser of the Kiskunság National Park, that he also found water-meal in the area of the communities Lakitelek and Alpár, in the hair-weed vegetation of the ox-bow lakes Kis-Sulymos and Nagy-Sulymos, as well as in the moorish waters of the high sedge associations in the Tőserdő. Its occurrence here can be brought into connection — taking into consideration the possibility of its spreading with water — with its appearance in the flatlands of Oszlár, Tiszaluc and possibly Szatmár. It is also not excluded that it has been living in all these mentioned areas from ancient time.

Likewise in 1976, my colleague A. LEGÁNY, nature conservancy superviser, found it at Tiszadob, in the ox-bow lake ot the river Tisza at Szelep. It was present there then in changing quantity, among *Stratiotes aloides, Hydrocharis morsus-ranae,* as well as *Spirodela polyrrhyza.* In the photograph attesting its presence, apart rrom it, *Spirodela* takes part and the total covering of both species is about 60 to 65 percent. Water-meal is hardly 8 to 10 percent of the amount of Spirodela. This datum is also to be connected with those mentioned above.

It was looked for and found, upon my request, also by I. D. PETHE, teacher in Beregsurány, in more than one place in the water of the marshy brook flowing through the Déda-forest past Beregdaróc and in the Tisza Dead-Arm named Badaló-szeg past

Tarpa, in June 1977. The Déda-forest similarly abounds in plant species of alpestrine distribution *(Galanthus nivalis, Scilla bifolia, Leucojum vernum, Isopyrum thalictroides, Anemone nemorosa,* etc. And the beech occurs — apart from Long-forest lying between Sárospatak and Sátoraljaújhely — alone here in the Great Hungarian Plain). In the forests of Tarpa *Crocus heuffelianus* and *Fritillaria meleagris* live and *Lacerta vivipara* is also wide-spread there!

After these, I found myself *Wolffia* in July 1977, in the Dead-Szamos, meandering in the confines of the community Fülpösdaróc where it occurred in the largest numbers among its biotopes observed so far in the flatland at Szatmár. At the river-sides, the fragments or degraded spots of *Salicetum albae-fragilis* stood, here and there mixed with alder, mulberry *(Alnus glutinosa; Morus alba, M. nigra),* and mostly acacia *(Robinia pseudacacia).* Below, the fringe was given by the multicoloured mosaic of associations bordering the water *(Phragmition, Potametum natantis, Chenopodietum rubri, Nanocyperion flavescentis, Eleocharitetum ovatae, Eleochari aciculari-Schoenoplectetum supini, Cypero-Juncetum, Echinochloo-Setarietum, Bidentetum tripartiti, B. t. xanthietosum, Rudbeckio-Solidaginetum,* etc.). In the water environment, there were mostly reed and bulrush *(Phragmites communis, Typha angustifolia, T. latifolia),* in separated stands and mixed, as well. There were to be seen a few *Schoenoplectus lacustris,* in clusters at the edge of water, resp. reeds, as well as *Butomus umbellatus.* At the river-side and along the reeds, there were often to be seen sporadically *Alisma plantago-aqautica* and *Lysimachia vulgaris,* and here and there *Oenanthe aquatica* in large numbers. Large carpets of floating hair-weeds were made by *Trapa natans,* smaller ones by *Hydrocharis morsus-ranae. Salvinia natans* could be seen here and there or rather it was missing from large areas. *Potamogeton natans* was floating in small numbers sporadically at the surface of water. Members of the submersible hair-weed were *Potamogeton crispus, P. gramineus,* and *Myriophyllum spicatum.*

Water-meal was to be found in several places, everywhere in a very dense stand. I have found here two large, more or less continuous habitats of it. Both of them took place 250–300 m long and in a 15–35 m broad zone. *Wolffia* also protruded into surrounding the stocks of reed and bulrush closely. It has covered, in the below described percentage, the water surfaces of the zone between the outer fringe of reeds and the line of the river-side in a space of changing breadth, in places sheltered from the wind and free from rolling water, in a water of 0.01–1.20 m depth. (It is to be remarked here that the 0.75–1.50 m water depth, mentioned in the Austrian literature, is not at all a determined interval in respect of the limits of the occurrence of *Wolffia.* I know from experience that in case of this floating species of tiny stature the depth of water is — if otherwise all the essential conditions for living are given — considerable only in so far as the rolling water resp. the sweeping effect of the wind does or does not prevail in the habitat. The dispelling work of wind makes alone impossible its occurrence in groups at the surface of the deeper water ranges. If the strength of the wind is bound by reeds or another dense vegetation of strong fibres then water-meal can multiply even at the surface of a 2 m deep water).

The relative quantitative relations, observed in one of the habitats (in 10×10 cm squares, at 100 percent total covering) were on July 1977 as follows:

Woffia arrhiza	60–90 p.c. (A–D: 4–5; K: V)
Spirodela polyrrhiza	10–25 p.c. (A–D: I–2; K: IV)
Lemna minor	8–10 p.c. (A–D: 1; K: V)

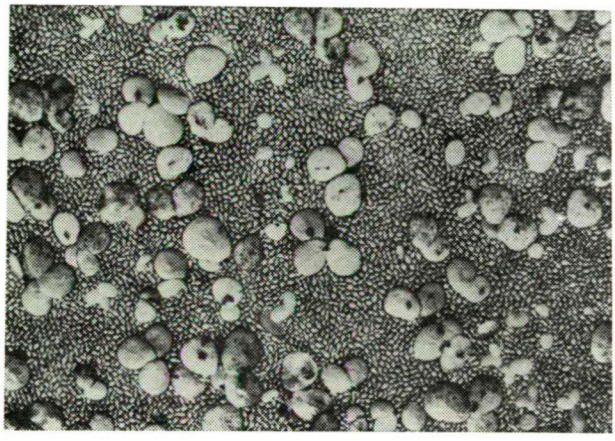
In the other habitat similar conditions were found but here, very sporadically, *Salvinia natans* also appeared (0–3 p.c.; A–D: 0 – +; K: I).

On 14 September 1977 the following relative quantitative relations were found in the Mill-pond at Csaholc (25×25 cm squares, at all surveys 100 percent total cover), in one or the other half of the ox-bow lake divided by the causeway built in this year:

I. *Wolffia arrhiza*	20–40 p.c. (A–D: 2–3; K:V)
Spirodela polyrrhiza	20–60 p.c. (A–D: 2–3; K:V)
Salvinia natans	10–55 p.c. (A–D: 1–3; K:V)

The stand is here and there interrupted by smaller or larger groups of Sparganium erectum, Sagittaria sagittifolia, and Nuphar luteum.

II. *Wolffia arrhiza*	70–90 p.c. (A–D: 4–5; K:V)
Spirodela polyrrhiza	10–20 p.c. (A–D: 1–2; K:V)
Salvinia natans	0–10 p.c. (A–D: 0–1; K:II)



Photograph 3. *Wolffia* stand in *Scirpo-Phragmitetum*. Fülpösdaróc. (Photo: I. FINTHA).

Here, along a many hundred metres stretch, this is the characteristic state. The appearance of the gutterless causeway, sundering the dead-arm, is a very regrettable event because it immediately severed the natural connections of the surrounding waters. Among our protective measures, it is unavoidably important to treat this question at length, as soon as possible.

At the same time, I have found newer habitats of wate-meal between Csaholc and Túrricse, in the longer, resp. horseshoe-shaped shorter ox-bow lakes, meandering in the neighbourhood of the left water-side of the dug Túr. Its recorded data, in

10×10 cm squares in the second dead-arm lying towards Ricse from the Borzsa-bridge, (at 100 percent total covering, on 14 September 1977) are the following:

Wolffia arrhiza	55–80 p.c. (A–D: 3–5; K:V)
Spirodela polyrrhiza	5–20 p.c. (A–D: 1–2; K:V)
Lemna minor	10–30 p.c. (A–D: 1–2; K:V)

In the next dead-arm towards Ricse, about 150 m long and 8–10 m broad an almost 100 percent pure cover is present (14 September 1977):

Wolffia arrhiza	95–100 p.c. (A–D: 5–5; K:V)
Lemna minor	0–5 p.c. (A–D: 0–1; K:I)

I have investigated, in the same period, into further waters but in those, enumerated below, I looked in vain for *Wolffia:* the waters of Déda-forest — Szipa-canal at Beregdaróc (only *Lemnetum;*) Gőgő's water at Nagyszekeres (only *Lemna* and *Spirodela);* water of the Szenke at Penyige (only *Lemna* and *Spirodela*): a longer stretch of the Túr in the confines of Túristvándi (only *Lemnetum*): bed of the Noborda in the Borzova-forest and the near-by canals on the confines of Nemesborzova (only *Lemnetum)*: Szamos dead-arms at Géberje, in the vicinity of Győrtelek and Tunyogmatolcs; the old ox-bow lake surrounding the church of Csengersima and the Vájás at Győrtelek-Kocsord. It is strange that I have also found entirely empty the horseshoe-shaped ox-bow lake in the area of the Ricse-forest which did not contain any water plant in spite of that I had found here water-meal first in the flatland of Szatmár-Bereg (1972).

In 1978, I did not find any newer habitat of water-meal, either. In the dead-arm at Fülpösdaróc its stand was poorer (July 6), on the other hand, I have observed here the appearance of *Lemna trisulca* in several spots.

I have not seen it either in the region of the Hortobágy or in the ox-bow lakes following the Tisza reaches between Ároktő and Tiszafüred although the ecological-coenological conditions would be satisfactory to it in most places.

Apart from publishing the most important information about the habitats, occurrences not cleared up so far of our plant, I have as a first task only summarized everything we can at present know about the state of water-meal in Hungary, completing it with the known few literary data. All this is, however, not much, and it can only inspire us to collect — using the existing bases — more and more material of this neglected species and — together with this — of the water associations, growing spaces which are in several respects (thus from economic point of view, as well) very considerable. It is, at any rate, necessary to continue its research because, apart from that the relations of its distribution are not cleared up, as yet, we are in want of knowledge of many parts of its ecology, as well.

The protection of Wolffia is suggested by KOVÁCS–PRISZTER (1977) but it is to be added that this can only be imagined by protecting the whole habitat. This would serve, at the same time, the conservation of several valuable, accasionally also rare, perishing plant and animal species, which is, at present to be accentuated more and more at any rate.

Last but not least, I should lik to express my profound appreciation to the folowing colleagues for helping me in bringing about this work by participating in observations and research: BENCZE, L. (Csaholc); KÓNYA, J. (Zsarolyán); LEGÁNY, A. (Tiszavasvári); D. PETHE, I. (Beregsurány); TÖLGYESI, I. (Kiskunság National Park, Kecskemét).

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A Wolffia arrhiza L. hazai elterjedésének revíziója

FINTHA I.

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Kivonat

Legkisebb virágos növényünk, a *Wolffia arrhiza (L.)* HORKEL EX WIMMER 1857., Európában az északi szélesség 55°-áig, illetőleg a 18 °C-os (ÉNy-Európában 17 °C-os) júliusi izoterma vonaláig minden síkségi területen elterjedt, hol elegendő a tápanyagokban gazdag (eutróf) állóvíz. Északon fekvő, hegységekkel teli vagy száraz klímájú országokban igen ritka, sőt hiányzik.

Hazánkban meglehetősen szétszórt elterjedésű, bár a vele kapcsolatos kutatások alaposabbá válásával elképzelhető, hogy jóval több élőhelyéről szerzünk tudomást. Korábban a Tiszántúlnak csak középső és délkeleti részeiből volt ismert, mikor 1972-ben megtaláltam a Szatmár-megyei Túrricse község mellett. A következő években egyre több új lelőhelyére akadtam a környéken s bebizonyosodott, hogy a Szatmár-beregi síkságon igen sokfelé él, sőt újabb tömeges előfordulásai is várhatók.

E tájon leginkább *Spirodela polyrrhiza, Lemna minor, Salvinia natans, Utricularia vulgaris* helyenként *Lemna trisulca* etc. között fordul elő különböző, megfelelő asszociációkban. A felsorolt fajokhoz viszonyított arányai a felvételekben átlagosan 60—80%-os értéket adnak [karakterisztikái: A—D=3—5, ill., 4—5 (5—5) között; K=(minden esetben) V.]. Nem ritka tiszta állományokban.

Ökológiájáról, elterjedéséről hézagos ismeretekkel rendelkezünk s biztos, hogy e kérdések további vizsgálata még számos információval fog szolgálni.

Javasolt védelme a vízi élőhelyek oltalmának szükségességét is jelenti, mely azok tudományos s gazdasági jelentőségével egyaránt indokolt.

Revizija rasprostra Wolffia arrhiza L. u Madjarskoj

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Abstract

Naša najmanja cvetnica *Wolffia arrhiza* (L.) HORKEL EX WIMMER, 1857., u Evropi je do 55° severne širine, odnosno do 18 °C (u Severozapadnoj Evropi do 17 °C) julske izotermne linije na svim ravničarskim područjima rasprostranjena u eutrofnim stajaćim vodama. U planinskim predelima severnih područja ili zemalja sa suvom klimom je veoma retka ili odsustvuje.

U našoj zemlji je prilično rasprostranjena, iako je na osnovu intenzivnijih istraživanja za očekivati njeno prisustvo sa više biotopa. Do sada je bila poznata sa srednjih i jugoistočnih područja is točno od reke Tise. 1972. god. smo je registrovali pored naselja Turricse u županiji Szatmár. Narednih godina smo registrovali sve veći broj biotopa u okolini i pokazalo se da je na ravničarskom području Szatmár-bereg široko rasprostranjena, kao i da je moguće očekivati njenu noviju masovnu

Na ovom području uglavnom se pojavljuje sa *Spirodela polyrrhiza, Lemna minor, Salvinia natans, Utricularia vulgaris,* ponegde sa *Lemna trisulca* etc. sa različitim i odgovarajućim asocijacijama. U ispitivanim probama, u odnosu na navedene vrste u proseku se javlja sa 60—80% (sa karakjeristikama: A—D=3—5 odnosno izmedju 4—5 (5—5); K=(u svim slučajevima) V.). Nisu retke njene čiste sastojine.

O njenoj ekologiji i resprostranjenju raspolažemo sa sporadičnim podacima. ali je sigurno tde istraživanja u ovom pravcuenpojavu nove informacije. Njena predložena zaštita u isto vreme će u prilog i potrebi zaštite vodenih biotopa, koja je kako sa naučne, tako i sa ekonomske strane oprovdana,

Исследование распространённости Wolffia Arrhiza в Венгрии

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Резюме

Самое мелкое цветочное растение нашей страны *Woiffia arhiza* (L') HORKEL ex WIMMER 1857 распространено на всех равнинных территориях Европы вплоть до 55° северной широты, то есть в пределах июльской изотермы в 18 °C (в Северо-запЕвропе — 17 °C), где достаточно богатой питательными веществами стоячей воды. В северных гористых странах с сухим климатом это растение является крайне редким, часто вообще не растёт.

В нашей стране распространённость его отличается большой разбросанностью, хотя можно предполагать, что более основательные исследования в этом отношении откроют их новые местонахождения этого растения. До того, как мною это растение в 1972 году было обнаружено в области Сатмар, село Туричче, оно было известно в нашей стране лишь в средней и юго-восточной части Затисайской обл. В последующие годы я находил всю больше местонахождений его в обл. Сатмар. Оказалось, что на равнине Сатмар-Береги есть много разновидностей его, более того, ожидаются новые места его массового распространения.

На этих почвах в различных соответствующих ассоциациях он встречается в первую очередь спеги *Spirodella pollirrhiza, Lemna minor, Salvinia natans, Utricularia vulgaris,* иногда *Lemna tricula* Как показывают взятые пробы, содержание его в перечисленных разновидностях составляло 60—80 % (характеристика: A—D=3—5 или 4—5(5—5); K= (во всех случаях). Нередко встречается в чистом составе.

Относительно экологии и распространённость *Wolffia arrniza* мы располагаем пока лищьнебогатым запасом знаний. Бесспорно, что дальнейшие исследования обогатят новой обширной информацией.

Рекомендуемая защита этого растения распространяется и на его водные местонахождения, что обусловлено их научным и экономическим значением.

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EFFECT OF LASTING FLOODS ON THE SPECIES COMPOSITION AND ORGANIC-MATTER PRODUCTION OF THE MARSHY MEADOW-LANDS IN THE FLOODPLAINS OF THE TISZA

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Abstract

In the grass-lands of floodplains enclosed between th levees of the Tisza, two associations may be separated. In the sections on higher levels *Lythro (virgatae)-Alopecuretum pratensis* BODROGK. 77 is dominant and in those on lower levels *Carici (melanostachyae)-Alopecuretum pratensis* Soó 71, showing a transition towards the flood-plain Magnocaricio. As a result of the lasting water-covering, the meadow association, composed by species components that require hygro-mesophilic environmental essential conditions, changes into a flood-plain grass-land of helo-hygrophilous character. In the years free from lasting flood-waves, the regeneration of *Lythro-Alopecuretum* begins. As an intermediary stage, a meadow overgrown with weeds develops. The development of this can be hastened by the missing of regular mowings. Consequently, the seeds of *Glycyrrhiza echinata, Lythrum salicaria, Iris pseudacorus, Glyceria maxima* and of other species will be spread by the floods. Their fast multiplication prevents, therefore, the spread of *Alopecurus pratensis*.

By the six years long systematical investigations an answer was given to the dominance relations, organic-matter productions of the species components of both meadow-associations, as well as to the change in the proportions of the living and dead matters.

The flood-plain of the Tisza is regularly covered by the spring flood-waves. Flood-free years rarely occur. Depth and lastingness of floods are, however, changing. And the local climatic conditions during floods are also different. As a result of these, the water covering of the vegetation may grow considerably warmer or colder and the species-selecting effect of flood may weaken or intensify.

In case of a lasting water-covering, the species-composition of the associations of the marshy meadow-lands, their phytomass production and zonation system change. The meso-hygrophytic species will be replaced by helophytic components. We wanted, on the way of our investigations, performed for several years, to obtain an answer to the qualitative and quantitative degrees of the changes in phytocoenoses taking place as a result of the lasting water-covered period, following the effect of floodwave-free or short-lasting inundations of shallow water-height.

Materials and Methods

The investigations began in 1972. There has proved to be the most suitable for this purpose a contiguous marshy meadow-land of several ha extension on the island Körtvélyes, taking place in the Tisza Nature Conservation District at Mártély, being the least disturbed by civilization effects.

Our observations which included the changes in the conditions of associations and the organic-matter production of the constant designated stands and in the hydrographic conditions of their habitats, as well as the clearing up of their physical and chemical characteristics, were repeated in the course of the growing period yearly more than once.

For the sake of keeping track of the changes, taking place as a result of the overground quantitative distribution of the phytomass and the abiotic effect of this, the cut organic matter was first selected into living and dead components and then the living material into species. After being dried, it was weighed in air-dried state. For determining the quantity of root-production, monolith was taken out from the soil of stands till 20, cm depth, in 5, resp. 10 cms.

The moisture-content of the soil was established for ml/cubic dm soil, and in the dry-weight percentage of the soil, and the total salt content on the basis of its electrical conductivity.

Terrain conditions of the marshy meadow-lands in the experimental area

Before building up the levees of the Tisza, the water mass of the melting snow from the Northern and Eastern Carpathiens, the Central Range of Mountains, and the Northern Great Hungarian Plain had brought about extensive but shallow inundations in the deeper situated areas of our Southern Plain (ANDÓ & VÁGÁS 1973). Consequently, the face of the landscape in that time was primarily characterized by a uliginal vegetation and helophytic gallery forests.

As a result of the levees built and raised higher and higher in the course of Centuries XVIII and XIX, the inundation areas outside the levees and the flood-plains within these sharply separate from each other, inrespect both of the vegetation and the hydrographical conditions. (BODROGKÖZY 1961, 1962, 1967; BODROGKÖZY–HORVÁTH 1972, HORVÁTH–BODROGKÖZY 1977.) In the flood-plains, the water mass of the spring and early-summer flood-waves can namely be as high as 3 to 4 m, as well. In the area of our investigations, e.g. in 1974, the water-covering was as high as this, for some months long. This had a devastating influence on the phytocoenoses of meso-hygrophilous character which had develope here, and in the years following the flood, a change of associative value took place in the vegetation.

In the flood-plain of Körtvélyes island considerable relief differences took shape. These partly are old riverbed-remains filled up, partly depressions brought about by the current of water, taking part as smaller or larger areas of stagnant waters. The soil of the area is an alluvial soil, prevented in its development by the accumulation of the silt and clay fractions, regularly and uninterruptedly transported by the flood-waves.

Containing no, or only very little, calcium-carbonate, it may be considered as an alluvial soil of acid or neutral reaction. In the area of stagnant waters, in the rooting zone, the accumulation of harmful sodium salts can here and there be demonstrated and can even reach 0.1 percent. This value is to be regarded as the lower limit of sodification (BALLENEGGER 1953).

The appearance of hydrogen sulphide, left behind after floods, getting warm in the summer season, and being formed in the course of the decomposition of the dead matter of vegetation may have a harmful effect on the composition of species components of the meadow-associations. Its presence can be ascertained already on the site by the opaline colour and characteristic smell of water.

Zonation of the plant-associations of the area

The deepest zone of the meadow plant-associations on Körtvélyes island is to be found in the dried-out dead-arms or at the side of those.

The species components of Potemetum lucentis Hueck 31 can accomodate

themselves well to the drying-up summer season, too. The pioneer plant-association of the riverside zone is *Polygono (amphibio)-Bolboschoenetum* BODROGK. 62, indicating a soil becoming more and more saline and turning into the stands of *Scirpo-Phragmitetum* W. KOCH 26. It contains large numbers of Schoenoplectus lacustris.

In the deep-lying areas of the island flood-plains with stagnant waters Caricetum gracilis Almquist 29, *Carici-Typhoidetum* SOÓ 71 and, in a smaller degree, *Glycerietum maximae* HUECK 31 predominate. Their spreading in years with lasting floods is more considerable and are connected together by several sub-association units.

In areas with boar-rootings, as a result of the intensive devastation, mud-vegetation: *Cypero-Juncetum* SOÓ et CSÜRÖS 44 occurs. The latter one is the dominant weed-association of the flood-plain plough-lands abandoned in the years with lasting floods.

In the higher situated areas of the flood-plain, among which the above mentioned marshy ecosystems, marshy meadows are mosaic-like wedged in, become dominant. Their species composition shows considerable differences, depending upon the degree and length of time of the water covering. In flood-free years or in those with short-term floods, *Lythro (virgatae)-Alopecuretum* BODROGK. 1977 predominates. After the formation of lasting flood-waves, mainly in years with many floods, *Carici (melanostachiae)-Alopecuretum* SOÓ 71, showing a transition to the Magnocaricion representatives of the marshy ecosystems of the flood-plain, takes over leadership.

Comparative investigations performed in the stands of Lythro-Alopecuretum, in case of different water-coverings

We have systematically investigated into the changes in the species combinations and organic-matter production of this marshy meadow, since 1972. For control, there are chosen from among the flood-free years or those with floods of short duration, the conditions in 1972 (Fig. 1).

Investigating into the state of the period in early June, immediately before mowing-time, it could be established that, in respect of its participation in covering, *Alopecurus pratensis* was dominant and showed, together with *Agropyron repens,* 80 percent participation in the total covering. In our area, the characteristic species of this association are — apart from the meadow foxtail — *Agropyron repens, Lythrum virgatum, Thalictrum flavum, Euphorbia lucida.*

In respect of their organic-matter production, in July, 86 percent of the total overground organic-matter production of the two dominating species was living matter. 82 percent of their root production takes place in the upper 5 cm layer of the soil.

The species composition of the association, the participation of the components in covering and the extent of their phytomass production show connection primarily with the hydrographical conditions of the habitat.

On the basis of the change in the moisture content of their soil, after flood-free periods or those with short-time water-coverings, here the hygromesophilous habitat relations are characteristic.

The autumn aspect was first investigated in September 1970. As compared with the summer states, there were considerable differences both in species composition and in the distribution of production. Its two characteristic species, *Glycyyrrhiza echinata* and *Lythrum virgatum* took part in 43 percent of the total production of phytomass. Their dominating role is still more remarkable if we take into consideration their participation in covering. After the withdrawal of species which can be observed in the course of the Autumn, their sudden advance is still more increased.

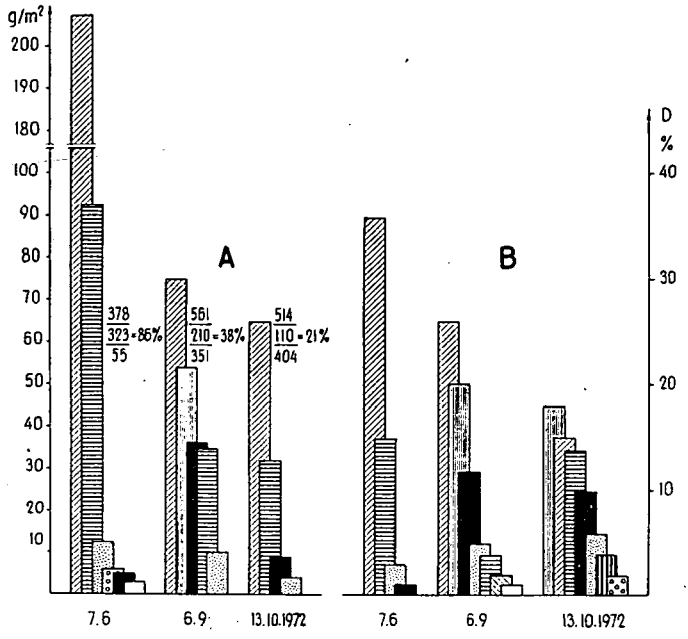
g/m²
200
190
180
100
90
80
70
60
50
40
30
20
10
D
%
40
30
20
10
A
B
378
323 = 86%
55
561
210 = 38%
351
514
110 = 21%
404
7.6
6.9
13.10.1972
7.6
6.9
13.10.1972

Fig. 1

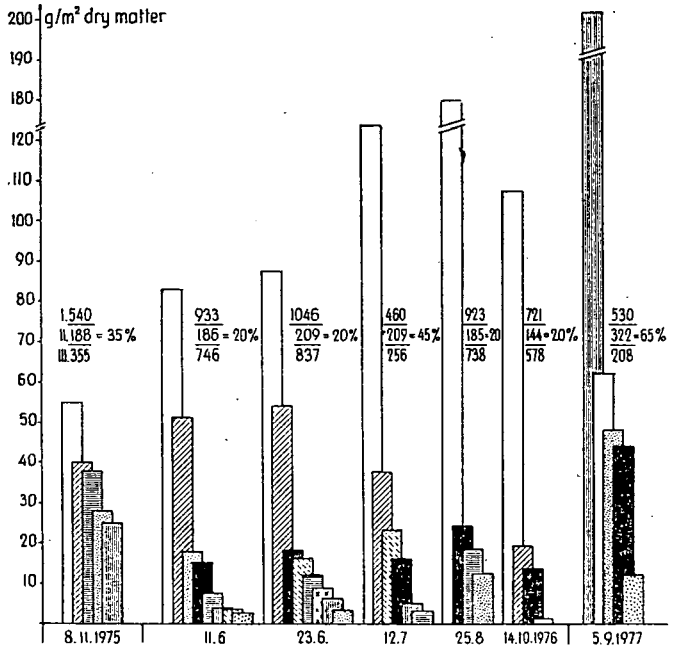
g/m² dry matter
200
190
180
120
110
100
90
80
70
60
50
40
30
20
10
1.540
II.188 = 35%
III.355
933
186 = 20%
746
1046
209 = 20%
837
460
209 = 45%
256
923
185 = 20
738
721
144 = 20%
578
530
322 = 65%
208
8.11.1975
11.6
23.6.
12.7
25.8
14.10.1976
5.9.1977

Fig. 2

The least change was shown by *Potentilla reptans* in the course of the growing season.

The ratio of the dead matter in the phytomass of the *Lythro-Alopecuretum* stands became in the course of the summer months six times as high as before. The flood-waves of the years between 1972 and 1977 are summarized in Fig. 2.

Effect of the lasting water-covering

In the Spring of 1974, our experimental area was covered by the longest-lasting flood-wave. The stands of the original *Lythro-Alopecuretum* became devastated almost entirely. And after the flood had passed, no stagnant water was left behind either in the observed area or in areas at similar levels. The regeneration of association could only begin at the end of Summer and the total covering was as high as 10 percent only at the end of September. From among the five species to be found, leadership belongs to *Glycyrrhiza echinata.* From among the *Lythrum* species, a few individuals of *Potentilla reptans* could only be observed. Adventitious species are *Carex melanostachya* and *Juncus compressus.* The covering-conditions of the stand are summarized from the Autumn of 1974 to the Autumn of 1977 in Fig. 3.

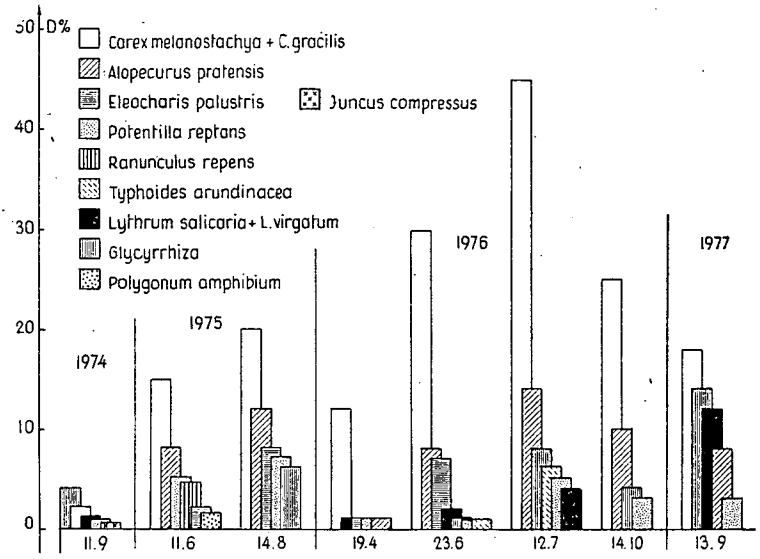

Fig. 3

In the growing season of the next year, our area was not touched by any lasting flood-wave (Fig. 2), the spreading of the species components of the marshy meadowland in the flood-plain therefore intensified. At any rate, within this the distribution of species, living and dead matters and the participation of these in covering showed a considerable change. In this way, *Carici (melanostachyae)-Alopecuretum* came about, forming a transition towards Magnocaricion in the flood-plain.

In spite of that the omission of the lasting water-covering is equally favourable for certain hygro-mesophilous species, like *Alopecurus pratensis, Ranunculus repens,* both in the spring and summar aspects, the helo-hygrophylous *Carex melanostachya* and *C. gracilis* have together reached even 20 percent D-value.

In the phytomass production of the developed phytocoenoses, the meadow foxtail has got, besides the Cyperaceae, the second place. *Glycyrrhiza echinata* is less sensitive to the damaging effect of a lasting water-covering. Its overground organic-matter production is therefore considerable.

The conditions of the growing period 1976 was investigated on four occasions, because the degree of the water-covering of the spring flood-wave was of high value and of shorter period. Its effect was the most striking in the spring period. Then the two Carex species sufferred the least damage. On the other hand, the D-value of the other components was still insignificant (Fig. 3).

In the summar season, June and July, the habitat conditions were the most favourable for *Carex melanostachya* and *C. gracilis* and achieved even a covering participation over 40 percent. The spreading of *Alopecurus* did not show any major difference as compared with the similar period of the preceding year.

It was repeatedly proved that the increased covering participation of *Glycyrrhiza echinata* always falls on the late summer period. To know this may be important mainly for the practice. From among the *Lythrum* species, *L. salicaria* is the dominant one and *L. virgatum* only occurs one by one.

In the autumn aspect, the total covering of the species components, and partly also the productivity of species, decrease.

In 1977, in the Körtvélyes reaches of the Tisza, as well, the lasting water-covering, as the main environmental ecological factor of the flood-plain ecosystems, was missing. Consequently, in the marshy meadow-land zone of the investigated area, the hygro-mesophilous species have again come into prominence. As, however, the spreading of *Alopecurus pratensis* was of lower tempo than expected, the regeneration of the species components of *Lythro-Alopecuretum* took place in a longer time. The quality of hay to be expected in the hayland was, namely, so much vitiated by becoming sedgy as a result of the lasting water-covering in the previous second year that the regular mowing and mainly the cutting of the second crop were omitted. It may be due to this that the husks of some "weed species" of the flood-plain, first of all those of *Glycyrrhisa* and large numbers of the *Lythrum salicaria* seeds were spread uniformly in the area by the floods. In this way, the area left free by the Carex species, already driven back for the Autumn of 1977, and *Alopecurus,* not having yet a suitable spreading in that time, was occupied by these species. With this can be explained the high participation of *Glycyrrhiza, Lythrum* and *Polygonum amphibium* in the total phytomass production (Fig. 3).

Practical relations of the results of investigation

It is a known fact that, as a result of the river barrages built in the Tisza successively, the water surface of the river-bed considerably increases. Consequently, the flood-plains get under a lasting water-covering more frequently. In the first place, the here and there extensive flood-plain grass-lands are mostly affected by the changing environmental effect.

The hayfields with speargrass and Lythrum have so far produced hay of acceptable quality and their cultivation has been profitable for the stock-breeding farmsteads. In the future, as a result of the more and more frequently returning lasting flood-waves, these hayfields will expectably become inferior in quality. Owing to the spreading of sedge species and other "weed species" requiring plenty of water, in

these flood-plain stretches sour hay will grow, unsuitable for foraging purposes. The multiplication of water mannagrass *(Glyceria maxima)*, yellow iris *(Iris pseudocorus)*, reed-grass *(Typhoides arundinacea)*, wolf's milk *(Euphorbia lucida)* but mainly of Glycyrrhisa echinata and Lythrum salicaria is also to be expected.

The considerable lost owing to the deterioration of grass-lands can be reduced by draining the remained stagnant waters immediately and it can even be prevented by planning and carrying out canalizing systems for draining water.

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Tartós áradás hatása a Tisza hullámtéri mocsárrétek fajösszetételére és szervesanyag produkciójára

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Kivonat

A Tisza árvédelmi töltései közé szorított hullámtéri kaszálókon két asszociáció különíthető el. A magasabb térszínű szakaszokon a *Lythro (virgatae)-Alopecuretum pratensis* BODROGK. 77 és az alacsonyabb térszínű szakaszokat uraló s a hullámtéri Magnocaricio felé átmenetet mutató *Carici (melanostachyae)-Alopecuretum pratensis* Soó 71. Tartós vízborítás hatására a hygro-mesophil környezeti életfeltételeket igénylő fajkomponensek alkotta réttársulás helohygrophil jellegű hullámtéri kaszálóvá alakul át. Tartós árhullámoktól mentes esztendőkben megindul a *Lythro-Alopecuretum* regenerálódása. Közbeeső stádiumként elgyomosodott rét alakul ki. Kialakulását a rendszeres kaszálás elmaradása gyorsíthatja. Ennek következtében a *Glycyrrhiza echinata, Lythrum salicaria, Iris pseudacorus, Glyceria maxima* és más fajok magvait az áradások szétterítik ezáltal gyors elszaporodásuk az *Alopecurus pratensis* térhódítását gátolja.

Hat éven át tartó rendszeres vizsgálatok választ adtak a két réttársulás fajkomponenseinek dominania viszonyai, szervesanyag produkcióira, valamint az élő- és a holtanyag arányainak változására.

Uticaj dugotrajnih poplava na floristički sastav i organsku produkciju plavnih područja i ritskih močvara reke Tise

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Abstract

Na livadama izmedju odbrandbenih našipa reke Tise javljaju se dve asocijacije. Na višim staništima ne nalazi *Lythro (virgatae) — Alopecuretum pratensis* Bodrogk. 77, a na staništima nižeg nivoa *Carici (melanostachyae) — Alopecuretum pratensis* Soó 71, kao prelaz ka Magnocaricii plavnih područja. Pod uticajem dugotrajnih poplava, umesto ritske asocijacije koja zahteva higro-mezofilne uslove života, javlja se helohigrofilna livada plavne zone. U godinama bez dugotrajnih poplava uspostavlja se regeneracija *Lythro-Alopecuretum* asocijacije. Kao medjustadijum javlja se zakarovljena ritska zajednica. Njeno pojavljivanje ubrzava izostanak redovnog košenja. Poplave obezbedjuju raseljavanje semena *Glycyrrhiza echinata, Lythrum salicaria, Iris pseudacorus, Glyceria maxima* i drugih vrta i njihovo brzo osvajanje sprećava rasprostiranje *Alopecurus pratensis.*

Ispitivanja u toku šest godina dala su odgovor na uslove dominacije floristićkog sastava vrsta ritskih zajednica, na organsku produkciju, kao i na odnose promena organskih i neorganskih materija.

Влияние продолжительного разлива на видовой состав болотистых лугов и продукцию органических веществ

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Резюме

На сенокосных лугах, лежащих между сооружёнными на Тисе дамбами по защите от наводнения, можно разграничить две ассимиляции. На участках сболее возвышенным рельефом — *Lythro (virgatae) — Alopecuretum pratensis* Bodrogk. 77. и господствую на участках с более низменным рельефом и представляющую собой переход к Magnocaricion *Garici (melanostachyae) — Alopecuretum pratensis* Soó 71.

Под влиянием длительного покрытия водой луговые сообщества, состоящие из видовых компонентов, требующих гидромезофильных жизненных условий, преобразуются в сенокосные луга пойм гелогидрофильного характера. В годы, когда не наблюдается длительный разлив, начинает регенерировать *Lythro — Alopecuretum.* В качестве переходной стадии формируется дернистый луг. Процесс его формирования убыстряется в случае отсутствия систематического кошения. При этом разлив способствует переносу семян *Glycyrrhiza echinata, Lythrum salicaria, Iris pseudacorus, Glyceria maxima* и других видов, быстрое размножение которых препятствует распространению *Alopecurus pratensis.*

Проведенные нами в течение шести лет систематические исследования дали ответ на вопросы относительно доминирующих отношений видовых компонентов двух луговых сообществ, их органической продукции, а также изменния соотношения живого и мёртвого вещества.

Весенние паводковые волны систематически затопляют пойму Тисы. Редко бывают голы, когда нет разлива. Однако длительность и сила наводнений различны. Различны и местные климатические условия в период наводнения. Под их влиянием заливающая растительный покров вода может в значительной степени или согреться, или охладиться, в силу чего «видоселектирующее» влияние наводнения либо слабеет, либо повышается.

В случае длительного полкрытия водой изменяется видовой состав сообществ болотистых лугов, их продукция в фитомассе и зональная система. Вместо мезогидрофитных видов появляются гелофитонные компоненты.

В ходе своих многолетних исследований мы пытались дать ответ на вопрос о квалитативном и квантитативном размере фитоценозных изменений, наступающих под влиянием безразливн ыхпериодов, а также периодов длительного водного покрытия, сменяющего непродолжительные разливы с незначительным поднятием уровня воды.

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REGION RECONSTRUCTION OF THE TISZA DEAD-ARM AT LAKITELEK ON THE BASIS OF THE ECOLOGICAL INVESTIGATIONS PERFORMED IN TŐSERDŐ

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Abstract

It can be ascertained on the basis of the plant ecological investigations carried out in Tőserdő and the Tisza Dead-Arm at Lakitelek that these Tisza reaches, in spite of the anthropogenous effects, are suitable for the region reconstruction. In the forests along the Dead-Tisza several autochthonous tree species revive even today and the macrovegetation of the dead-arm is abundant, as well.

Conditions of executing the region reconstruction are:

(a) Owing to the siltation of the river bed taking place since the river control, rising of the water-surface of the dead arm by 1 to 1.5 m.

(b) Safeguarding a slow flowing through the dead-arm, in compliance with the water movement, correnspondig to the meanders before the river-control. After creating these physical conditions. the reintroduction of the plant and animal species which were characteristic of the water and river-side associations but exterminated because of anthropogenous effects.

Introduction

One of the areas of high priority of the Tisza research is the region of Csongrád. The investigations performed here are justified first of all by that in the near future the building of River Barrage III in Hungary begins, connected with the so-called Alpár Reservoir. The Tisza Dead-Arm at Lakitelek and Tőserdő, in the vicinity of the planned Reservoir, represent great natural value and have, therefore, been, already since 1955, nature conservation areas. Since 1975, they have composed one of the blocks of the Kiskunság National Park the area of which is 382 ha (KOPASZ 1976). This Tisza Dead-Arm and its environs are comparatively free of anthropomorphous effects, thus they are suitable to re-establish the pre-regulatory Tisza landscape. The aim of the plant-ecological investigations performed in the area is first of all to promote the region reconstruction initiated by the Tisza-Research Working Committee.

Literary survey

The first botanical description of Tőserdő originates from 1896. L. BAGI is writing in his book "Kecskemét múltja és jelene" (Past and present of Kecskemét) as follows: "The nicest forest of Kecskemét is Tős along the Tisza, consisting mainly

of oak plantations, interspersed with maple-trees, poplars, alders and ash-trees, hazel and broom bushes while farther, at the dam, the willow becomes dominant... The hop twists itself round trees, intertwined with bramble-trailers. Here and there wild vines can be seen as they wind round trees."

Its association relations were first elaborated in detail by I. BALOGH in 1951. In 1953, in the framework of the national plant-geographical surveying, L. TIMÁR worked in this area. He describes in greater detail the vegetation of the fenwoods and gallery forests along the Tisza of which the dominating willow-plantations are characteristic *(Saliceto populetum albae)*. According to TIMÁR, the groves extending along the dams are generally pastured. Their underwood is, therefore, very weedy *(Aristolochia clematitis, Physalis alkekengi, Urtica dioica, Agropyron repens)* and *Rubus caesius* occurs in large mass.

During the 25 years since the survey considerable changes have taken place. The forests along the dead-arm are cultivated. There occur introduced, plantation-like cultivated forests, as well. The branches of the old willows are no more pruned regularly. But from the shape of trees, the earlier frequent prunes can be concluded. *Amorpha fruticosa* and *Vitis riparia,* occurring today already in large numbers, are not mentioned by TIMÁR. The two plants multiplied, therefore, in this area in the last decades. In SIMON's opinion (1969), the forest types *Salicetum triandrae, Salicetum albae fragilis,* and *Fraxino pannonicae-Ulmetum* which are characteristic of the flood-plains along the Tisza, have mostly survive in Tőserdő.

CSAPODY and SZODFRIDT (1970), surveying the natural plant associations of the country, suggest Tőserdő as the main conservation area of Salicetum-albae fragilis. The region reconstruction initiated by the Tisza-Research Working Committee in the area is, therefore, unambiguously justified.

Materials and Methods

The Tisza Dead-Arm at Lakitelek and Tőserdő lie 30 km east of Kecskemét. Their geographical co-ordinates are: longitude 19° 30' east, latitude 46° 45' north. Tőserdő and its environs are shown in Fig. 1.

Its height above sea level is 80–90 m, its soil is sporadically peaty alluvial soil. The dead-arm is joined from west by an area with sand-hills. Its climate is continental the extremities are, however, considerably reduced by the flood plain. The mean annual temperature is about 10 °C. The many years' average of the mean January temperature is −1.8 °C and that of the mean July temperature is 21.9 °C. The mean annual precipitation is 497 mm. The area gets under water in case of major floods. This at last happened in 1977.

Our investigations were performed in three forest stands on the northern river-side of the northern dead-arm, 2 to 4 ha each, in the Summer of 1977 (Fig. 2).

At marking out the stands, we have taken into consideration the request of the Kiskunság National Park. These stands are the following:

(a) *Salicetum albae-fragilis* ISSLER 26 (type of the willow plantation),
(b) *Salicetum albae-fragilis* ISSLER 26 (type of the poplar plantation,
(c) *Fraxino pannonicae-Ulmetum pannonicum* Soó 63 (consolidation of *Quercus robur)*.

The coenological surveyings were performed in stands, in three repetitions, and in 20.20 sq.m squares. The covering of the single layers and the participation of species were determined with assessing, according to Braun–Blanquet's scale. The height of the forest was similarly established with assessing. The distribution of species according to floral elements and way of life was determined in pursuance of Soó (1964). In the appointed stands, and for a basis of comparison, a stand-climatic examination was carried out in the open plough-land, on two occasions, all day long. The micro-climate of the dead-arm was measured, as well, thus conclusions could be drawn in respect of the effect of dead-arm and forest upon the micro-climate. In the course of our investigations, the temperature of air was measured with alcohol thermometers in five strata depending on the plant stand, in two strata, with mercury thermometers, the temperature of the soil, and in the dead-arm those

of water and mud. The intensity of illumination was measured with luxmeter, the speed of wind with hand cup anemometer. The vapour content of air was determined with Assmann's aspiration-psychrometer, and the temperatures of the soil and water-surface with thermistor spot-thermometer.

Simultaneously with the coenological surveyings, the total leaf-surface falling on 1 sq.m of the herb stratum was also determined, as well as the wood mass of the three forest types, by means of forest valuation tables.

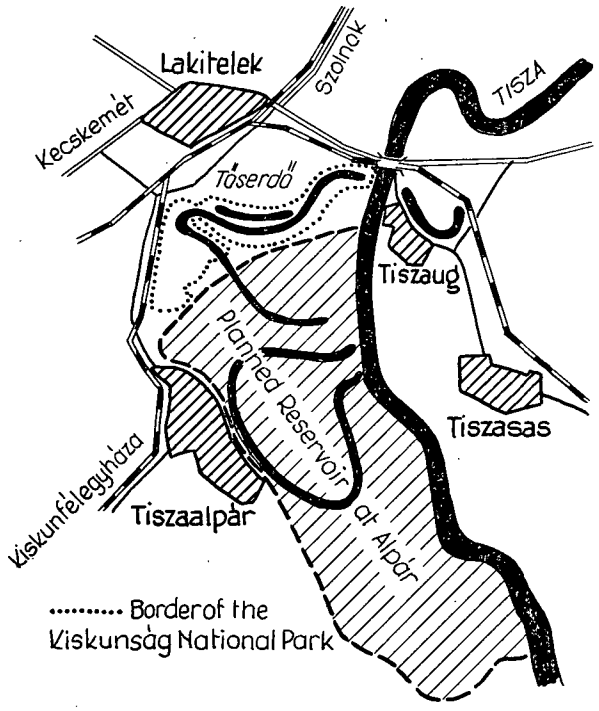


Fig. 1. Tőserdő and environs.

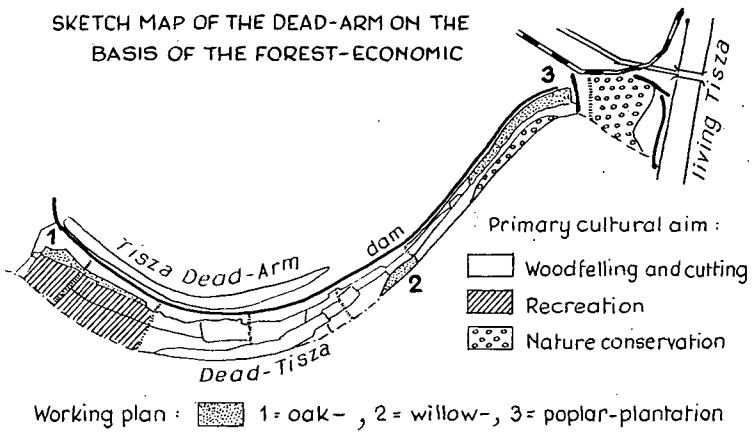


Fig. 2. The investigated stands along the northern part of the dead-arm.

Table 1. *Species composition of Salicetum albae fragilis* ISSLER 26 (willow type)

Floralelement	Life form	Species	Surveys					K	A-D
			1	2	3	4	5		
Tree stratum									
Eura	MM—M	Salix alba	4	5	5	5	1	5	4
Eur	MM	Fraxinus angustifolia ssp. pannonica	3	2	1	1	–	4	1,75
Adv	M—E	Vitis riparia	2	+	+	+	–	4	0,5
Eura	MM—M	Populus nigra	–	–	2	–	1	2	1.5
Adv	MM	Morus alba	–	+	–	1	–	2	0,5
Eura	MM—M	Salix fragilis	–	–	–	–	5	1	5
Shrub stratum									
Adv	M	Amorpha fruticosa	1	–	–	5	5	3	3.7
Eur	MM	Fraxinus angustifolia ssp. pannonica	5	–	–	2	–	2	3.5
Adv	M—E	Vitis riparia	+	–	–	–	–	1	+
Adv	MM	Morus alba	–	–	–	+	–	1	+
Herb stratum									
Eur	MM	Fraxinus angustifolia ssp. pannonica	5	2	+	1	+	5	1.6
Eura	H (N)	Rubus caesius	1	3	1	3	+	5	1.6
Adv	M—E	Vitis riparia	1	2	1	2	1	5	1.4
Adv	M	Amorpha fruticosa	+	+	2	+	2	5	0.8
Eur-Med	MM—M	Quercus robur	1	+	1	+	+	5	0.4
Atl-Med	G	Leucojum aestivum	+	+	+	+	+	5	+
Kozm	H	Potentilla reptans	+	+	+	+	+	5	+
Eur-Med	H	Carex sp.	+	–	4	+	5	4	2.3
Eura	Ch	Solanum dulcamara	–	+	+	1	1	4	0.5
Cir	G	Equisetum arvense var. ramulosum	+	+	–	+	+	4	+
Eura	HH	Lycopus exaltatus	–	+	+	+	+	4	+
Med	H (G)	Aristolochia clematitis	2	3	–	2	–	3	2,3
Eur	H	Symphytum officinale	+	2	–	2	–	3	1.3
Kozm	H	Urtica dioica	–	1	–	1	+	3	0.7
Eura	Th	Polygonum minus	–	+	–	1	+	3	0.3
Kozm	H	Calystegia sepium	–	–	+	+	1	3	0.3
Kozm	Th	Bidens tripartitus	–	–	+	+	+	3	+
Eur-Med	G	Iris pseudacorus	–	+	+	–	+	3	+
Cir	H (G)	Stachys palustris	–	–	+	+	–	2	+
Kozm	Th	Xanthium strumarium	–	–	+	–	+	2	+
Eur	MM—M	Ulmus minor	+	–	–	–	–	1	+
Adv	MM	Morus alba	+	–	–	–	–	1	+
Cir	H	Galium palustre	–	+	–	–	–	1	+
Eura	H	Myosotum aquaticum	–	–	–	+	–	1	+
Eura	Th	Cuscuta australis	–	–	–	–	+	1	+

Discussion and evaluation of results

Coenological description of stands

Salicetum albae fragilis ISSLER 26 (willow type)

It developed close to the water, in a low stratum, having two types. One of these is formed by parky old, *stick-like* willows, with young ashes and a few mulberry trees. The shrub stratum is low, its covering is of small size, and that of the herb

stratum is middle-sized. The characteristic species of these two strate are: *Fraxinus angustifolia* ssp. *pannonica* seedlings, *Rubus caesius, Vitis riparia, Amorpha fruticosa Aristolochia clematitis, Symphytum officinale, Leucojum aestivum. Vitis* creeps sometimes up to the tree stratum, as well.

The soil of the other type of willow plantation is wet, in some places the water cover even exists in the second half of July.

The willows in this type are lower and they are "bearded" until about 2 m height. Apart from *Salix alba, S. fragilis* also appears. The shrub stratum is unimportant, the herb stratum is very unequal: its cover changes between 0 and 80 percent.

Our coenological survey is summarized in Table 1.

Among the species, the Eurasian elements are dominating but there are also several cosmopolitan and adventive elements.

From among life forms, phanerophytons and Hemikriptophytons dominate. This agrees with the data published by SIMON (1957) about the forests in the northern Great Plain, but the proportion of geophytons is here higher (Fig. 3).

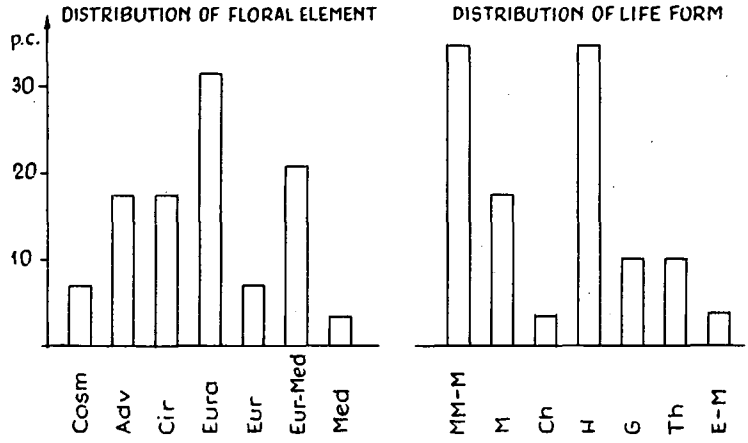


Fig. 3. Distribution of the floral element and life form of *Salicetum albae fragilis* ISSLER 26 (Willow type)

Salicetum albae fragilis ISSLER 26 (poplar type)

It takes place close to the dead-arm but in a stratum 1.5 to 2 m higher than the willow type. The forest mostly consists of *Populus alba* and *P. canadensis* but there occur among these *Populus canadensis* and, close to the water, *Salix alba,* too.

The forest is parky, the shrub stratum is well-developed. Its dominant species are: *Amorpha fruticosa, Fraxinus angustifolia, Celtis occidentalis, Morus alba, Frangula alnus, Crataegus monogyna, Ulmus minor.* It occurs that the latter species form a second shrub stratum above the strongly closed *Amorpha fruticosa* stratum. *Vitis riparia,* creeping often on the trees, as well, is characteristic of the stand.

The herb stratum, as compared with both "willow types", is richer in species and here are the dicotyledons dominant. It depends on the shrub stratum, how closed it is. Its dominant species are *Rubus caesius* and *Aristolochia clematitis.* There are many *Amorpha fruticosa,* as well as *Celtis, Frangula, Ulmus, Crataegus* seedlings and young shoots. And even *Populus alba* and *Quercus robur* occur.

Our coenological survey is summarized in Table 2.

Table 2. *Species composition of Salicetum albae fragilis* ISSLER 26 (poplar type)

Floralelement	Life form	Species	Surveys 1	2	3	4	5	6	K	A—D
Tree stratum										
Eur	MM—M	Populus alba and canescens	4	3	4	3	4	4	5	3.7
	MM—M	Populus canadensis	4	2	3	3	2	2	5	2.7
Eura	MM—M	Salix alba	–	3	–	–	2	–	2.5	1.7
Adv	M—E	Vitis riparia	–	2	–	–	+	+	2.5	0.7
Adv	MM—M	Morus alba	–	–	–	–	+	–	0.8	+
Eura	MM	Fraxinus angustifolia ssp. pannonica	–	–	–	–	+	–	0.8	+
Shrub stratum I										
Adv	MM	Celtis occidentalis			3	2			5	2.5
Adv	MM	Morus alba			2	2		+	3.3	2
Eur	MM	Fraxinus angustifolia ssp. pannonica			2	+		+	3.3	1
Eur-Med	M	Crataegus monogyna			2	–			2.5	2
Eura	M	Frangula alnus			2	–			2.5	2
Adv	M—E	Ulmus minor			–	2			2.5	2
Shrub stratum II										
Adv	M	Amorpha fruticosa	5	3	5	2	2	3	5	3.3
Adv	M—E	Vitis riparia	2	3	1	5	4	4	5	3.1
Eur	MM	Fraxinus angustifolia ssp. pannonica	+	2	–	+	2	2	4.2	1.2
Adv	MM	Celtis occidentalis	1	–	2	1	1	+	4.2	1.2
Adv	MM	Morus alba	1	1	–	+	–	2	3.3	1
Eur-Med	M	Crataegus monogyna	–	–	1	–	–	–	0.8	1
Eura	Th	Acer negundo	–	+	–	–	–	–	0.8	+
Eura	M	Frangula alnus	–	–	–	+	–	–	0.8	+
Eur	M—MM	Ulmus minor	–	–	–	+	–	–	0.8	+
Herb stratum										
Med	H (G)	Aristolochia clematitis	4	1	4	3	3	3	5	3
Eur-Med	H (N)	Rubus caesius	3	4	2	3	3	3	5	2.7
Adv	M	Amorpha fruticosa	2	2	1	2	+	1	5	1.3
Adv	M—E	Vitis riparia	2	2	2	2	+	+	5	1.3
Adv	MM	Celtis occidentalis	1	–	2	+	–	+	3.3	0.8
Eura	MM—M	Populus alba	1	1	+	1	–	–	3.3	0.8
Aur	MM	Fraxinus angustifolia ssp. pannonica	–	+	–	+	1	1	3.3	0.5
Eur	MM—M	Ulmus minor	–	–	+	+	1	+	3.3	0.2
Eur-Med	H	Carex distans	–	+	+	–	+	+	3.3	+
Eura	H	Glechoma hederacea	–	+	+	+	–	+	3.3	+
Eur-Med	MM—M	Quercus robur	–	+	+	+	–	+	3.3	+
Cir	G	Equisetum arvense	–	1	–	–	+	+	2.5	0.3
Eura	M	Frangula alnus	–	+	1	–	–	+	2.5	0.3
Eur-Med	M	Crataegus monogyna	–	+	+	–	–	+	2.5	+
Eur-Med	G—HH	Iris pseudacorus	–	+	+	–	+	–	2.5	+
Eur-Med	M	Phyrus achras	1	–	–	+	–	–	.6	+
Eura-Kozm	H	Calystegia sepium	–	+	–	–	+	–	1.6	+
Cir	H	Vicia cracca	–	+	–	–	–	+	1.6	+
Cir	H	Stachys palustris	–	+	–	+	–	–	1.6	+
Eura	H H	Lycopus exaltatus	–	–	+	+	–	–	1.6	+
Adv	MM	Morus alba	+	–	–	–	–	–	0.8	+
Cir	H	Prunella vulgaris	–	–	+	–	–	–	0.8	+
Eura	Th	Setaria viridis	–	+	–	–	–	–	0.8	+
Eur	Ch	Lysimachia nummularia	–	–	+	–	–	–	0.8	+
Cir	H	Galium palustre	–	–	–	–	+	–	0.8	+
Kozm	H	Urtica dioica	–	–	–	–	–	+	0.8	+

From among the floral elements, the Eurasian species dominate. But the number of adventive, circumpolar and Euro-Mediterranean species is also comparatively considerable.

The proportion of phanerophytons and hemikriptophytons is approximately corresponding (Fig. 4).

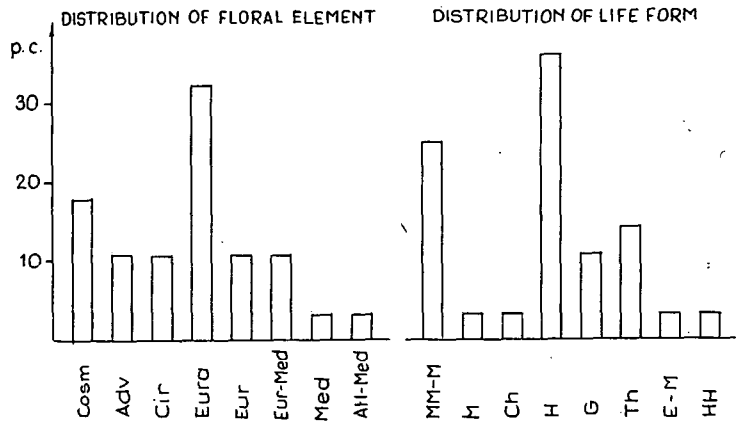


Fig. 4. Distribution of the floral element and life form of *Salicetum albae fragilis* ISSLER 26 (poplar type).

Fraxino pannonicae - Ulmetum pannonicum Soó 63 *(Quercus robur consociation)*

This stand can also be divided into two "types". The tree stratum of one of these is formed by high, slenderly built roburs, their trunk diameter being 40 to 50 cm. In the shrub stratum *Amorpha fruticosa* is "thick as a brush". A herb stratum only develops where the shrub stratum is not closed. The latter is formed here and there by the pure stand of *Equisetum arvense ramulosum.*

In the other type of the oak plantation the tree stratum is similar but below that a well-closed second tree stratum is formed by *Fraxinus angustifolia* and *Ulmus minor.* The shrub stratum and herb stratum are unimportant because of this double tree stratum.

Our coenological survey is shown in Table 3.

As compared with the oak-forests in the northern Great Plain (SIMON 1957), the number of circumpolar elements is high and it is also richer in Euro-Mediterranean and adventive elements. The distribution of life forms also agrees with the oak-forests in the northern Great Plain, only the number of geophytons is somewhat higher (Fig. 4).

The height of stands and the cover of the single strata is contained by Table 4.

Subsoil-water content

From among the stands, the soil of the poplar plantation was the driest. The cause of this is primarily the higher stratum and the loose sandy soil. The soil of the oak plantation is less sandy and its water content forms a transition from poplar to willow plantations (Fig. 6).

Table 3. *Species composition of Fraxino pannonicae – Ulmetum pannonicum* Soó 63

Floralelement	Life form	Species	Surveys 1	2	3	4	K	A—D
Treet stratum								
Eur-Med	MM—M	Quercus robur	5	5	5	5	5	5
Adv	M—E	Vitis riparia	–	1	+	+	3.8	0.3
Shrub stratum I								
Eur	MM	Fraxinus angustifolia ssp. pannonica	–	4	–	4	2.5	MM 4
Eur	MM—M	Ulmus minor	–	3	–	3	2.5	3
Shrub stratum II								
Adv	M—E	Vitis riparia	1	2	+	+	5	0.8
Adv	M	Amorpha fruticosa	5	–	4	5	3.8	4.3
Eur	MM	Fraxinus angustifolia ssp. pannonica	1	4	4	–	3.8	3
Eur	MM—M	Ulmus minor	–	3	+	–	2.5	1.5
Herb stratum								
Eur	MM	Fraxinus angustifolia ssp. pannonica	2	3	2	3	5	2.5
Eur-Med	H (N)	Rubus Caesius	2	3	2	2	5	2.3
Adv	M	Amorpha fruticosa	2	1	2	1	5	1.5
Adv	M—E	Vitis riparia	1	1	2	1	5	1.3
Eur	MM—M	Ulmus minor	+	2	1	1	5	1
Eur-Med	MM—M	Quercus robur	1	+	+	+	5	0.3
Cir	G	Equisetum arvense var. ramulosum	3	1	+	3	3.8	2
Med	H	Aristolochia clematitis	+	2	2	1	5.8	1.3
Eur-Med	H	Carex sp.	1	–	1	+	3 3.8	0.7
Eura	M	Frangula alnus	+	–	+	+	3.8	+
Cir	H	Vicia cracca	+	–	–	+	2.5	+
Cir	Th	Atriplex hastata	+	–	–	+	2.5	+
Kozm	H	Calystegia sepium	–	–	+	+	2.5	+
Eur	H	Symphytum officinale	+	–	–	–	1.3	+
Cir	Th	Erysium cheiranthoides	+	–	–	–	1.3	+
Eura	HH	Lycopus exaltatus	+	–	–	–	1.3	+
Eura	Ch	Solanum dulcamara	+	–	–	–	1.3	+
Atl-Med	G	Leucojum aestivum	–	–	+	–	1.3	+

Table 4

Stand	Herb stratum 1	2	Shrub stratum 1	2	Tree stratum 1	2
Salicetum albae fragilis (willow plantation)	43	0.3	10	4.0	66	11.0
Salicetum albae fragilis (poplar plantation)	55	0.5	60	3.0	58	22.0
Fraxino pannonicae–Ulmetum	40	0.4	73	3.0	58	22.0

1 = cover (percent)
2 = height (m)

Wood mass of the stands (Sopp 1977):

Salicetum albae-fragilis (type of willow plantations)	410 c. m/ha
Salicetum albae-fragilis (type of poplar plantations)	500 c. m/ha
Fraxino pannonicae – Ulmetum pannonicum	600 c., /ha

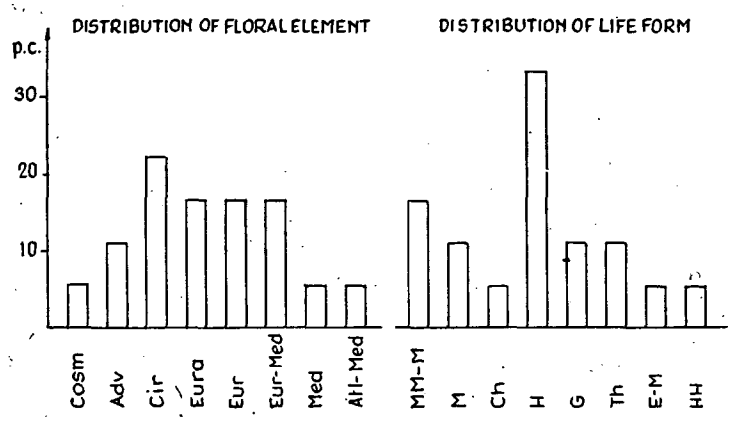


Fig. 5. Distribution of the floral element and life form of *Fraxino pannonicae – Ulmetum pannonicum* Soó 63.

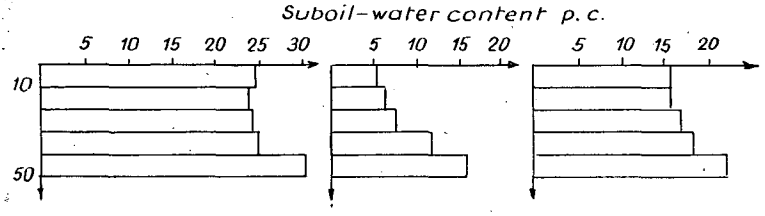


Fig. 6. Water content of the soil of stands:
1 = *Salicetum albae fragilis* Issler 26 (willow type)
2 = *Salicetum albae fragilis* Issler 26 (poplar type)
3 = *Fraxino pannonicae – Ulmetum* Soó 63

Stand climate

On the basis of the investigations into the stand climate on 29 June 1977, the following can be established:

In the open plough-land and in the dead-arm, as well as in the willow-poplar gallery forest, the daily averages of the air temperature, in a height of 190 cm, differ hardly. But in the extreme values of temperature, the difference is considerable. It may be mentioned as an example that while in the plough-land the daily range of thermometer in this height is 20.4 °C in the forest it only is 11.0 °C and in the dead-arm not more than 14.3 °C, either.

In the soil temperature, in the three stands, even the averages differ considerably. The difference is, in 2 cm depth, 24.0 °C, in the forest it is 17.0 °C and in the mud of the dead-arm 17.9 °C. The daily fluctuation is also very different. This is, 2 cm deep, in the open plough-land 16.8 °C, in the forest 2.8 °C and in the mud of the dead-arm it is not more than 1.2 °C. It can be ascertained therefore, that the temperature fluctuations particularly in the soil, are strongly moderated by the dead-arm and the adjacent comparatively narrow forest belt.

In the forest and above the dead-arm, the relative vapour content of the air is about 10 percent higher than in the open plough-land area (78, resp. 68 percent).

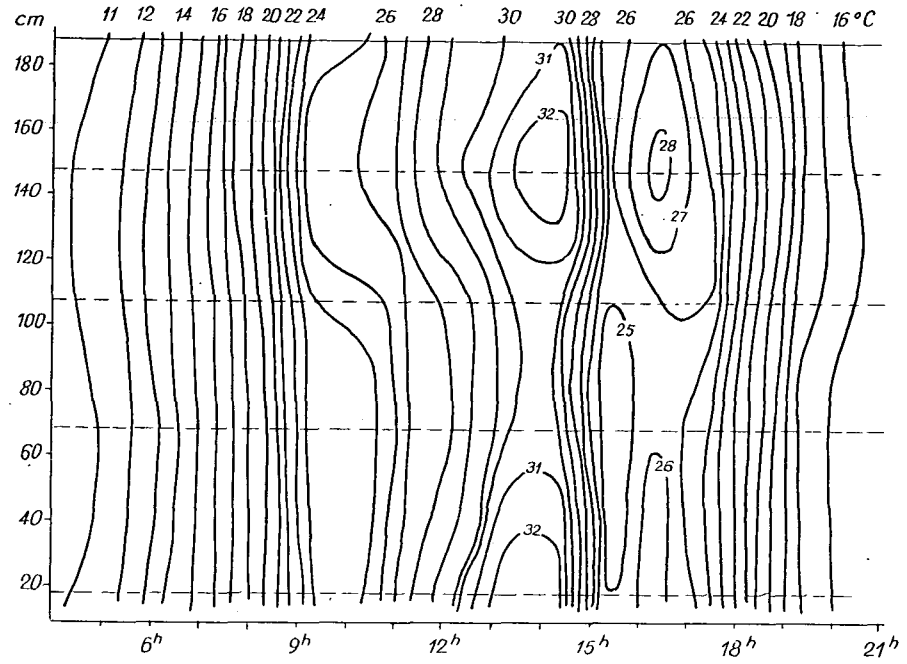


Fig. 7. Air-temperature isoplates of the open plough-land (29 July, 1977).

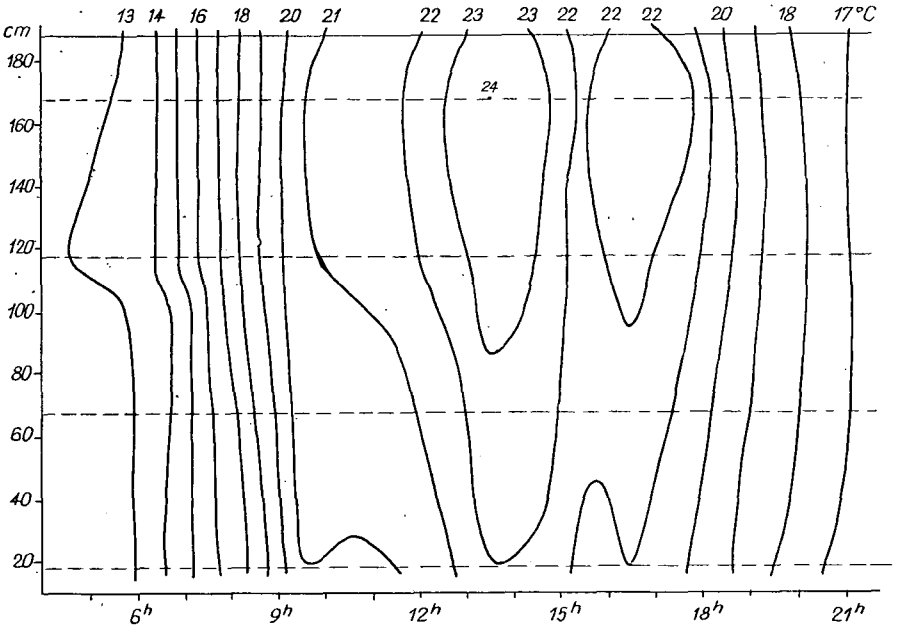


Fig. 8. Air-temperature isoplates of *Salicetum albae fragilis* Issler 26 (willow type) (29 July, 1977).

The daily fluctuation of the relative vapour content is similarly about 10 percent less (40, resp. 51 percent).

From the results of the investigations into the stand climates, the details of the isoplates of air temperature are shown in Fig. 7 to 9.

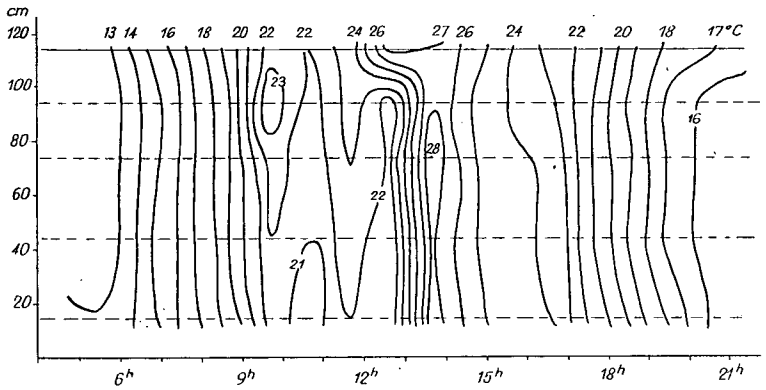


Fig. 9. Air-temperature isoplates of the dead-arm. (29 July, 1977)

Reconstruction of the dead-arm and its evnironment

It can be established on the basis of our investigations that the anthropogenous effect taking place of late decades in the Tisza Dead-Arm at Lakitelep and the adjacent forest fringes is considerable. In spite of this, some autochthonous tree species are revived even today *(Quercus robur, Ulmus minor, Fraxinus angustifolia* ssp. *pannonica, Alnus glutinosa),* and among the plants of soft stalk, *Leucojum aestivum, Arum maculatum, Urtica Kioviensis, Iris pseudacorus* are also to be found. The vegetation of the dead-arm, which is free of the damages by the herbivore fishes, is particularly valuable.

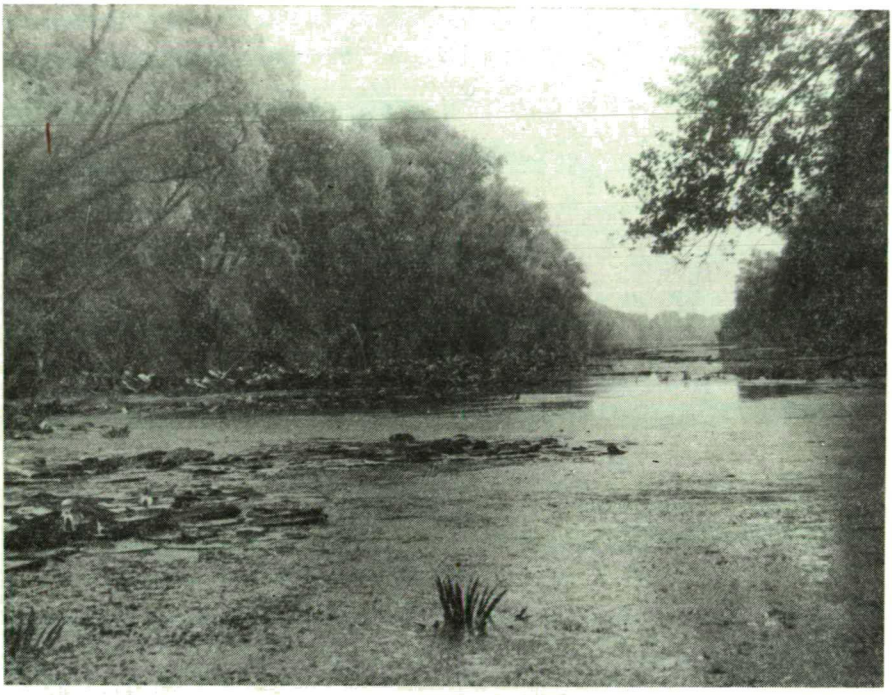
In the shrub stratum the largest change — and, at the same time, the greatest problem — is caused by *Amorpha fruticosa* being present in large numbers.

The microclimate moderating influence of the dead-arm and forest is considerable what is an important abiotic condition of region reconstruction.

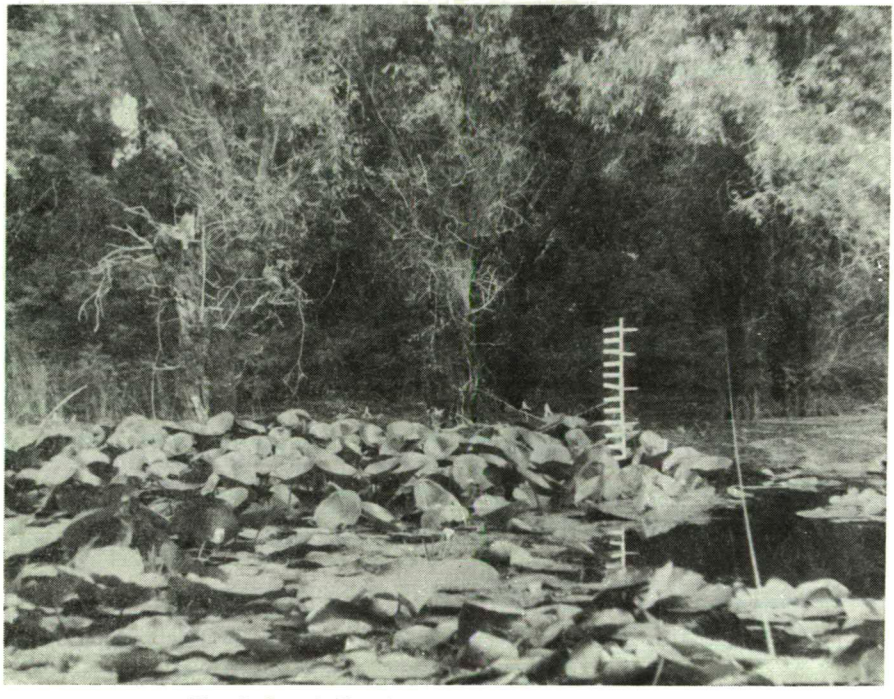
Parallel with our investigations, there took also place water-chemical and algological investigations in the Tisza Dead-Arm at Lakitelek (Szűcs 1978, Kovács 1978). The plans of region reconstruction were elaborated after taking these into consideration. We have departed from that the meandering slow waterflow was characteristic of the lowland stretch of the ancient Tisza before river control. The physical conditions of this must first be ensured then, following this, the animal species, exterminated owing to the anthropogenous influences, ought to be reintroduced.

Two things are necessary to ensure the above conditions:

(a) Owing to the siltation of the river bed,taking place since the river control, rising of the water surface of the dead-arm by 1 to 1.5 m. Dredging of the river bed would also mean some solution but it would be more difficult to put this into practice.



Pict. 1. Tisza Dead-Arm at Lakitelek.

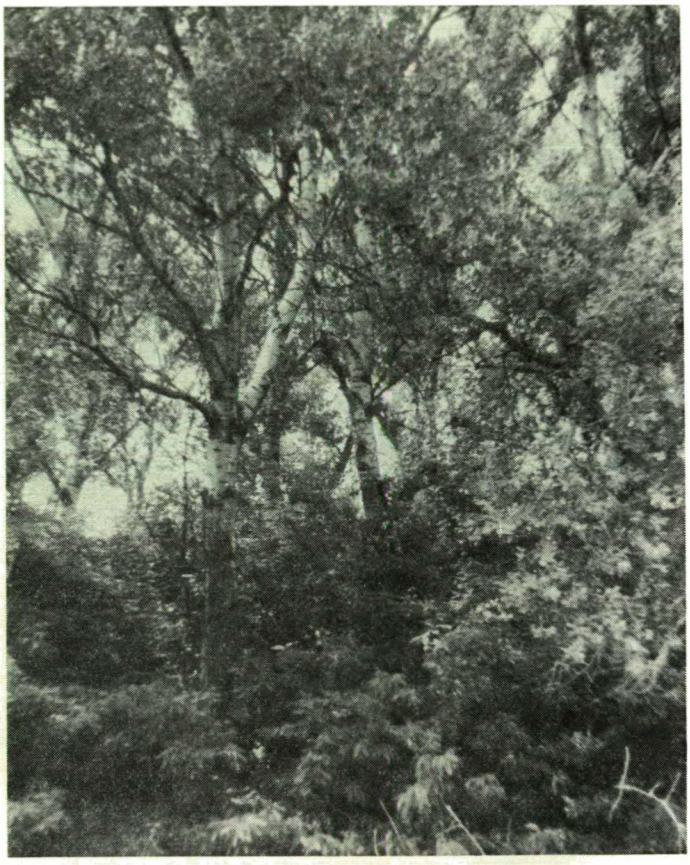


Pict. 2. Stand-climatic investigation in the dead-arm.

Pict. 3. Willow type of *Salicetum albae fragilis* ISSLER 26.

Pict. 4. *Quercus robur* consociation of *Fraxino pannonicae – Ulmetum pannonicum.*

(b) Safeguarding a slow flowing through the dead-arm, in compliance with the water movement, corresponding to the meanders before the river-control. This can be solved by building two sluices and lift stations in a way that the water surface of the dead-arm should always be independent of the water surface of the living Tisza. The detailed biological reconstruction of the dead-arm and its environs can be elaborated and realized after carrying out these precautionary measures.



Pict. 5. Poplar type of *Salicetum albae fragilis* ISSLER 26.

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A lakiteleki Holt-Tisza tájrekonstrukciója Tőserdőn végzett ökológiai vizsgálatok alapján

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Kivonat

Tőserdőn és a lakiteleki Holt-Tiszán végzett növényökológiai vizsgálatok alapján megállapítható, hogy e Tisza-szakasz az antropogén hatások ellenére is alkalmas tájrekonstrukcióra. A Holt-Tisza melletti erdőkben több őshonos fafaj még ma is felújul, és a holtág makrovegetációja is gazdag.

A tájrekonstrukció megvalósításának feltételei:

(a) A szabályzás óta bekövetkezett meder feltöltődés miatt a holtág vízszintjének 1—1,5 m-rel történő megemelése.

(b) A szabályozás előtti meanderekre jellemző vízmozgásnak megfelelően lassú átfolyás biztosítása a holtágon. E fizikai feltételek megteremtése után a vízi- és vízparti társulásokban a jellemző, de antropogén hatások miatt kipusztult növény- és állatfajok visszatelepítése.

Rekonstrukcija predela Mrtve-Tise kod Lakitelek-a na osnovu ekoloških ispitivanja u Tőserdő-u.

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Abstract

Na osnovu ispitivanja u Tőserdő-u i na Mrtvoj-Tisi kod Lakitelek-a moguće je utvrditi da ja područje reke Tise i pored antropogenog uticaja pogodno za rekonstrukciju predela. U šumamo pored Mrtve-Tise još se i danas više autohtonih drvenastih vrsta obnavlja, a takodje je i mrtvadj bogata makrovegetacijom.

Uslovi za realizaciju rekonstrukcije predela:

(a) Podizanje nivoa vode za 1—1,5 m., koje je neophodno usled podizanja dna mrtvaje za vremena regulacije toka reke Tise.

(b) Obezbedjenje sporog protoka vode na mrtvajama, koji je bio karakterističan za meandre pre regulacije toka reke Tise. Nakon obezbedjenja ovih fizičkih uslova naseljavanje za vodenu i priobalsku zonu karakterističnih biljnih i zivotinjskih vrsta, onih koje su pod uticajem antropogenih faktora izumrle.

Восстановление ландшафта реки Холт-Тиса (Мёртвая Тиса) в районе Лакителек на основании проведенных в Тёшэрдё экологических исследований

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Резюме

На основании ботанико-экологических исследований, проведенных в Тёшэрдё и Лакителек, установлено, что, вопреки антропогенным влияниям, эта часть Тисы является пригодной для восстановления ландшафта. В прилегающих к Мёртвой Тисе лесах регенерируются многие древесные сорта-аборигены, макровегетация мёртвого русла также является богатой.

Условия осуществления восстановления ландшафта:

а) поднятие водного уровня в русле на 1—1,5 м из-за обмеления русла, произошедшего со времени регулирования;

б) обеспечение соответствующего медленного протекания через мёртвое русло водного потока, характерного для предшествующих регулированию меандров. После создания этих физических предпосылок — обтарное насаждение или внедрение сортов растений и разновидностей животных, характерных для водных и прибрежных сообществ, вымерших в результате антропологенных влияний.

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PLANT ASSOCIACIONS OF FLOOD PLAINS ALONG THE MIDDLE TISZA AND THEIR AGRICULTURAL UTILIZATION

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(Received 17 June 1978)

Abstract

The authors have investigated some flood-plain areas belonging to the Middle Tisza Region and extending south of Kisköre and Abádszalók till Pusztataksony, from the points of view of their economic usefulness, as well as the macro- and micro-element content of the plant associations. The soil of the river-side and the flood-plain areas is a middling acid fresh alluvial soil. The humus content and the flood-plain areas is a middling acid fresh alluvial soil changes between 1 and 1.42 percent, the pH between 5.3 and 5.6 (measured in nKCL).

According to the establishment of the authors, the investigated areas are utilized first of all forest-economically and only 10—12 percent grassy area utilized with mowing, resp. paturing. With the intensive Canadian poplar plantation the original willow-poplar-ash plant association strongly decreases and the original plant cover of the shrub and herb stratum of the forest association also considerably changes. As a result of the more and more frequently arising region conservation problems, it is pressing and justified, to declare these areas a Region Conservation District!

In the course of investigating into the macro- and micro-element content of plant species of the plant association in the flood-plain areas, the authors have ascertained that the mean values of the macro- and micro-element content of the plant associations the river-side and in the flood-plain exceeded in every case the mean values of the meadow-hay of good quality. The authors have examined the plant species 6 macro- and 7 micro-elements in a double repetition (in spring and autumn aspects).

The flood-plain areas of the Danube and the Tisza come to 10 percent of the territory of this country even to day. The agricultural utilization of the Danube and Tisza flood-plains — wich can be regarded as considerable compared with the territory of the country — may be very much varied, depending on the character of the flood-plain area. In the Danube flood-plains, less protected with artificial dams, the field growing of plants can be carried out without any major danger even in the immediate flood-plain. The Danube flood-plains can be utilized in a large measure as pastures and grass-lands, too. At the same time, their utilization in forestry by means of planting of trees is also not negligible. And, particulary at present, even the recreation areas spring up like mushrooms in the Danube flood-plains. Along the Tisza, well-protected with dams, the afforestation of flood-plains prevalls while the flood-plain areas utilized as pasturages and grass-lands are of much smaller size.

Before the protection against floods and the river control works started in the Eighteen-Forties, vast areas are inundated by the floods of the Danube and particularly of the Tisza. In case of the Tisza and its tributaries the extension of the annually

inundated areas reached 30,000 square km. All this already belongs to the past today. The meandering Tisza was made straight with 300 short cuts, its flowing was forced into a deeper riverbed, flowing more rapidly.

The enormous social intervention after the liberation of the country made the Tisza a real "canalized artificial river" for our days, satisfying the requirements prescribed by the up-to-date agriculture and the other branches of peopel's economy. The river barrage built in 1954 at Tiszalök and the 108 km long Eastern Main Channel of about 650 cubic m/sec. transportability and the Kisköre River Barrage, finished in 1976, the huge reservoirs in the flatlands, all are important chain-links of the work the aim of which is to make the Tisza one of our most useful rivers for a long time.

The fluviatile deposit of the Tisza water is of mildly acid reaction and in the water of the river the amount of solute salts and other floating-matters is remarkably large. The different salts make about 66 percent of the solid suspension passing with the water (MIHÁLZ, 1939). The analysis of the floating-matter of the Tisza (BABOS, 1952) is the following: feldspar 66.56 percent, kaolin 12.51 percent, sand 2.30 percent, calcium-carbonate 2.82 percent, ferric oxide 3.19 percent, humidity 4.43 percent, organic matter 8.29 percent. In the organic matter, nitrogen is represented with 0.15 percent. One cubic m Tisza water carries 324 g silt on the average and in that the amount of potassium is 0.9 percent, that of lime 37.5 g averagely. The overweight of the non-decomposed feldspar in the floating-matter of the Tisza is particularly important because this — owing to its low clay content — does not stop the gap-system of the ground in the course of floods, and after being decomposed it increases the productivity of soil at a rapid pace. Not less important is the favourable quantity of lime in the silt of the Tisza which has a useful effect on the physical properties of the floating-matter (loosening, capacity of taking up water) and makes advantageous to introduce intensively calcium-demanding fruit and poplar-species in the flood-plains and river flats. The total salt content of the floating-matter of the Tisza was at Kisköre, in river-km section 404, on the basis of the data recorded by the "VITUKI" between 1973–1976: maximum 486 mg/l, mininum 142 mg/l, on average: 292 mg/l. ("VITUKI" data, 1 March 1978.)

It has been generally known for long that the alluvial grounds are much richer in mineral matters than the other grounds. The floating-matter of the Tisza covers at flood 1 ha inundated area with 48–103 kg vegetable nutritive matter. The productive effect of the deposit is commonly known.

As the Tisza regularly inundates the flood-plain areas at least once a year — if not twice-even today —, we may draw conclusion that in these areas the base-destroying processes are lasting even at present. It is known that in the direction of the flowing of rivers upper, middle and lower reaches and in perpendicular direction to that, departing from the riverbed: (1) the presentday flood-plain or immediate river flats, (2) the older or secondary flood-plain beyond the protecting dam, and (3) the dry river terrace may be distinguished. In the latter two — as these had no more obtained any regular overflow — the processes of soil formation could already begin in the alluvium. In the direct flood-plain is, however, the river in a standing activity, even at present. It carries away a considerable part of the material is deposited at the former inundation — although today this is already considerably diminished by the trees of the thickly afforested flood-plains — and deposits new matters. In the immediate flood-plain can, therefore, the formation of a ground type not begin.

Plant coenological and ecological investigations were performed in large numbers in the flood-plain areas both of the Danube (KÁRPÁTI 1963, SOÓ 1958, 1960, 1961, 1964, TÓTH 1958, 1959, ZÓLYOMI 1967, ZSOLT 1943) and of the Tisza (BODROGKÖZY

1961, 1962, 1966, 1967, 1968, 1972, 1974, HORVÁTH 1974, MÁTHÉ–SOÓ 1939, SIMON 1957, TIMÁR 1939, 1954, 1956, UJVÁROSI 1940, 1941, ZÓLYOMI 1945, 1947). Since 1975, we also carried out investigations into some plant associations found in several flood-plains at the Danube (Sződliget, Verőcemaros, Tát, Almásfüzítő) and the Tisza (Tokaj, Tiszafüred, Tiszasüly, Nagykörű, Csataszög), first of all from the point ofi view of their macro- and micro-element content.

In 1977, we investigated into about 4 km long flood-plain areas, extending from, Kisköre and Abádszalók, belonging to the Middle Tisza Region, till Pusztataksony on the basis of the points of view given in the title of our paper. On the plant cover of the perambulated and investigated areas, the settlements and establishments to be found an information is furnished in the annexed sketch map (Fig. 1). It is shown

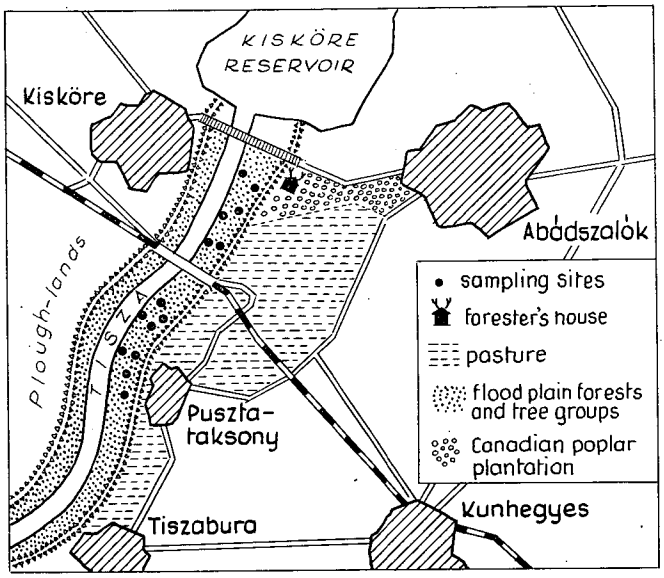

Fig. 1

in the sketch map that of the flood-plain areas, inundated by the Tisza regularly every year mostly the forest association in the secondary flood-plain areas outside the protecting dam however, the grassy associations and the field growing of plants are characteristic. Investigating into the sketch map, it can also be seen that, because of the intensive expansion of human settlements (particulary at Kisköre) as well as of the building of the Kisköre River Barrage, the landscape of the region and its natural primary plant cover change in a short time. And by this, inevitably, more and more nature conservation problems are raised. This is otherwise shown by the masses of rubbish, building debris, branches of trees broken off, empty cans, waste paper seen at our visit in the Kisköre flood-plain areas. We can only speak in superlatives of the measures of our Government with wich it will, in the next future, declare nature conservation area this district together with the whole Middle Tisza Region.

Geological and soil conditions of the investigated areas

The areas lying on the right river-side (Kisköre and its environs) belong geomorphologically to the Zagyva–Tarna basin of the open flood-plain of Heves–Borsod, and that being on the left river-side (Abádszalók–Pusztataksony) to the geomorpho-

logical district named Nagykunság. The flatness of the areas, seeming to be monotonous, is variegated at the right river-side by the new-Pleistocene alluvial cones of a comparatively very low difference in level, while at the left river-side by the original and artificial hillocks of not higher difference in level than 5 to 10 m from the Nagykunság "clod" left out of the Holocene settling (kunhalmok=tumuli, barrows). (BULLA 1962).

The soils of the investigated areas are according to STEFANOVITS (1963), structureless, fresh alluvial soils of mildly acid reaction in the flood-plain. In the secondary flood-plain areas, they are partly meadow soils of alluvial character, containing islandlike about 10 percent of alkali soils partly those very much disposed to sodification. These meadow soils form a transition through a series of grades to the more middle-hound soils of the sandridges in Heves in a distance of about 15 km. The characteristically clay meadow soils of the areas beyond the dams are explained by the comparatively high subsoil water, the inland waters appearing often in Spring, Winter and Autumn, and having no outlet. The anaerobic conditions, predominating in the soils of both the primary and secondary flood-plain areas shown by the increasing gleization of the soils. All the described main characteristics of the meadow soil having developed under hydromorphic conditions (SZABOLCS 1974) could be observed in the soil samples of the secondary flood-plain areas investigated.

Climatic and phytogeographic conditions

Phytogeographically the investigated areas belong to the floral district Crisicum of the floral province Eupannonicum, while from climatic point of view they are under the influence partly of the climatically varied Northern Highlands, partly of the climate of the drier, warmer Great Hungarian Plain. According to Köppen's climate classification, its climate may be characterized with the formula Cbfx, with 550–580 mm precipitation on the average, its mean monthly temperrature being below 22 °C in July, and about −2 °C in January or a little above that. The number of the very cold winter days being 30 to 35, according to the recent 10-year data of the Centra Meteorological Office, and that of the frosty days 170 to 180. The total precipitation of the summer semester is 300 to 350 mm. Humidity in the month July is 60 to 65 percent. The annual sum of sunshine is 2000 to 2200 hours. The prevailing direction of wind is north, north-east, and in a smaller degree west, southwest. Strenght of the wind is >3°.

Hydrographical conditions

The water quality of the Tisza was, according to the data of "VITUKI", at Kisköre, in the sector of river-km 404, in the years 1973–1977, according to the water-quality classification COMECON, "second class", "a little polluted", and according to its mineralmatter content "first water-quality class", "clear". Here are the mean values of the inorganic-matter content, measured in the Kisköre region of the Tisza water between the years 1973–1977:

Calcium ion	49.2 mg/l average
Magnesium ion	10.6 mg/l average
Sodium ion	22.– mg/l average
Potassium ion	4.1 mg/l average
Chloride ion	36.– mg/l average
Sulphate ion	43.7 mg/l average
Manganese ion	0.29 mg/l average
Methylorange alkalicity mg equ./l	2.49 mg/l average
Total solute matter	292.– mg/l average

Table 1. *Basic research values of soil samples from the river-side and flood-plain of the Tisza at Abádszalók*

Samples: I-III depth: cm	pH		$CaCO_3$ p.c.	Humus content p.c.	Total N gN	Phen. alkalinity sodic p.c.	Q	Arany's fixity No	Fe^{++} p.c.	5 h cap Water raising mm	Plant association from which the soil sample originates
	H_2O	n KCL			1000 g soil		450 650 mμ				
I.					(0–80 cm)		(0—80 cm)				Upper one-third of the Tisza river-side 1977. VI. 1.
0–40 cm	6.2	5.6	1.7	1.05	1.7	–		44	7.2	180	*Rorippo-Agropyretum repentis* (Timár 47)Tx 50)
40–80 cm	6.1	5.6	1.1	1.0	1.7	–	0.310 0.221	40	4.8	202	
II.					(0–80 cm)		(0–80 cm)				Primary flood-plain 1977. VI. 1.
0–40 cm	6.0	5.5	1.92	1.21	1.85	–	0.337 0.302	50	7.8	158	*Salicetum albae-fragilis* (Issler 26 et Soó 57)
40–80 cm	5.7	5.2	1.05	1.42				47	6.5	167	
III.					(0–80 cm)		(0–80 cm)				From the grassy area close to the protective dam in the primary flood plain
0–40 cm	6.4	5.8	2.27	1.30	1.63	–	0.565 0.633	46	5.6	195	*Carici-Alopecuretum*
40–80 cm	6.2	5.6	1.72	1.41				44	4.1	200	(Soó 71)

The mean water level of the Tisza in the area investigated was 187 cm, taking into consideration the data of the last five years. (Point "0" of the water-gauge was 81.71 m above the Adriatic). The highest water-level observed in this area in the past five years was 887 cm, having occured on 4 March 1977. Since the beginning of the observations (1889) the highest water in the Tisza, the area of Kisköre, was 902 cm, having occured on 27 May 1970. The protected dam was not overflown by the flood-wave. The Tisza leaves its middle-water bed in the stretch at Kisköre–Pusztataksony in case of 650 cm water-level.

At the record in May 1970, the flood-plain was covered by the inundation of the Tisza for 92 days. The lowest water observed in the Tisza at Kisköre in the last five years was −214 cm, on 5 October 1973.

The Tisza shows — similarly to our other home rivers — seasonal periodicity. There occur systematically a spring-summar largewater period (March–July) and an autumn small-water period (August–November). In the winter months, the water of the Tisza is generally low. In cretin years, however, owing to the melting on the snow, following the quick rise in temperature, the winter small-water period may be interrupted by a violent flood-wave (Aujeszky, 1941).

Methods of the investigation

The survey of plant associations was carried out 2×2 m squares. The plant species and associations follow the nomenclature of Soó–Kárpáti: Növényhatározó (Handbook of plant identification II (1968). On the riverside plant associations there were taken in the spring (1 June) and autum aspects (22 September) at 3 sites in each case, i. e. totally, 12 surveys, and on the flood-plain plant associations, at two sites each, together 4 surveys. For indicating the covering value the modified Braun-Blanquet-scale was used. From the stand types of plant associations on the Tisza river-side the soil samples were taken, till 80 cm depth, with drillhole, in the flood-plain with pit-digging, on the 1. June 1977. Soil properties were examined with complex agrochemical methods, in conformity with the Hungarian Methodological Directives on soil examinations (basic research). The mobile nutritive matters of the soil were determined with two kinds of methods: (1) in 0.1 n hydrochloric acid of room-temperature, dissolved at 1 to 10 soil-solvent ratio, (2) in ammonium lactate, dissolved according to Egne–Ruehm–Domingo, partly with atomic absorption, partly colorimetrically. The measuring of pH took place with H_2O and in n KCL solution. The determination of humus content was carried out with ignition weight losses, that of $CaCO_3$ content with the method of Mrs. Sátori, that of the total nitrogen content after Kjeldahl's decomposition with Nessler's colour-reaction.

The macro- and micro-element content of plants was determined after incinerating ignition at 600 °C, and after preparing partly with nitric acid — perchloric acid, partly with ammonium-lactate, on the basis of atomabsorptive measuring (K, Ca, Mg, Na, Mn, Zn), as well as colorimetrically (P, S, Cu, Mo, Al, Fe, B).

For information we make known the basic research values of the soil samples taken from three plant associations of the flood-plain of the Tisza at Abádszalók and the values of their mobile nutritive matters measured with two methods.

Investigation into the plant associations

In the 3–400 m broad flood-plain extending from the river-side of the Tisza at Abádszalók, the following plant associations can can be separated zonally:.

(1) Plant associations closely at the riverside: There were found two of these on the river-side at Abádszalók:

(a) in the lowest, silty section of the river-side: the mud-lover association *Bidentetum* (Koch 26) Libbert 32 (pp) *Dichostyli–Gnaphalietum uliginosi,* being a transition towards the *Bidentetum tripartiti* association,

(b) in the middle and upper sections of the river-side: the hydrophilic association Rorippo Agropyretum repentis (Timár 47) Ty. 1950.

Table 2. *Values of the mobile nutritive matter of the soil samples taken from the riverside and flood-plain areas of the Tisza at Abádszalók, dissolved in hydrochloric acid and ammonium lactate solution*

Samples I–III 0–80 cm	Dissolved in 0.1 n hydrochloric acid with 1:10 soil solutio ratio						Dissolved in ammonium- lactata-te solution				Plant assoc. from the soil-sample of which the investigation took place
	K	Ca	P	Mg	Fe	Cu	K	P	Mn	Zn	
	mg/kg soil						mg/kg soil				
I.	223	5 080	24	654	11 000	32.5	225	23	140	49.6	*Rorippo-Agropyretum repentis* (Timár 47) Tx 50 1 June 1977
II.	205	4 850	20	550	12 200	39.4	210	20	154	69.2	*Salicetum albae-fragilis* (Issler 26 et Soó 57) 1 June 1977
III.	235	5 220	26	642	10 600	32.7	238	27	136	56.3	*Carici-Alopecuretum* (Soó 71) 1 June 1977

(2) Plant association in the soft-wood gallery forest of the flood-plain. Two of this were found in the area at Abádszalók:

(a) The original *Salicetum albae-fragilis* (Issler 26 et Soó 57) association, and:

(b) The artificially planted Canadian poplar association: *Populus canadensis* Mönch. var. *marylandica* (Bosc) Rheder et var. *serotina* (Hartig) Rheder.

The latter one being an artificially planted plant association, we do not deal with it in detail.

(3) In a mesohygrophilous, grassy, half-ruderal area, in some plots planted with very young Canadian poplars extending 40 to 50 m broad between the soft-wood gallery forest and the protecting dam: *Carici-Alopecuretum* (Soó 71) association.

The plant associations made known are spatially illustrated by the sample spot and cross-section from the river-side of the Tisza at Abádszalók in Fig. 2.

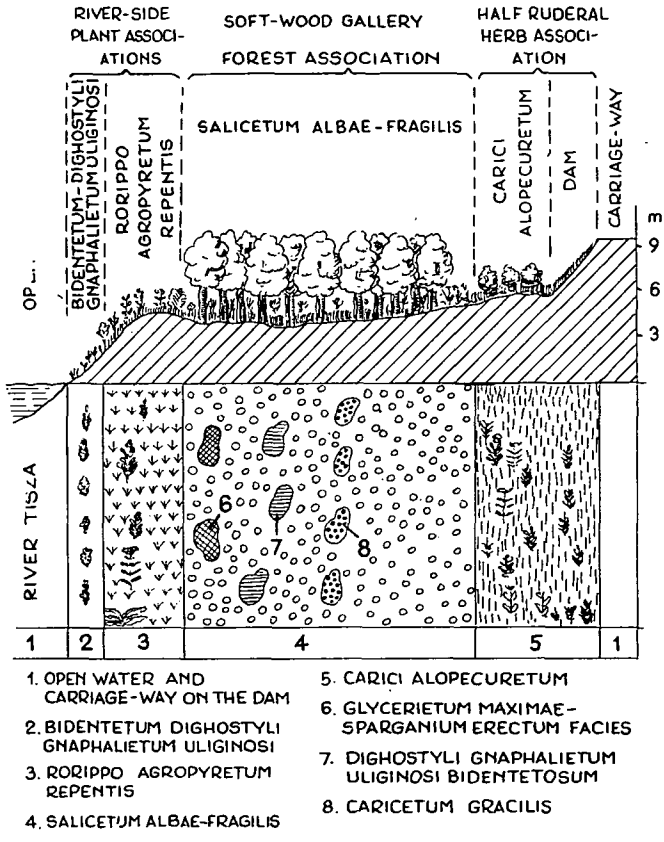

Fig. 2

A brief characterization of the plant associations investigated

(1) (a) *Bidentetum* (Koch 26) Libbert 32 (pp.) *Dichostyli–Gnaphalietum uliginosi* mud-lowing tansitional association. It is a plant association of the about 1.5 m broad, moderately ascending, muddy (troubled by the wawes and standingly wet), lowest

section of the river-side. Its species number is, because of the permanent motion and eluating effect of water, low enough. We could count not more than 19 species. The degree of covering is 60 percent. It cannot be utilized agriculturally. In the area no soil examination was performed. K index: 60 percent.

(1) (b) *Rorippo–Agropyretum repentis* (TIMÁR 74) Tx 50: hygrophilous association on the river-side.

It is an association taking place from the wet middle section of the river-side till the top of bank, and even jutting out here and there, in a breadth of 1.5 m, to the flood-plain, as well, which is characteristic of almost the full length of the investigated reaches. In the Canadian poplar grove planted about 1 km long, beginning from the highway bridge at Kisköre, Agropyron repens-Heleochloa alopecuroides forms a nice stock. Covering in this association is everywhere 100 percent. Its species number is richer than that of the former river-side association: 28. Because of its strongly ruderal species elements, this association can only be utilized in a small degree agriculturally altough, at the time of our visit, some grazing cows could be seen in this area. Soil properties can be found in Tables 1. 2. K index in 80 to 85 percent. (Figs. 3–4).

(2) (a) *Salicetum albae-fragilis* (ISSLER 26) et Soó 57 association.

This is an original plant association which can be found fragmented in some sections of the flood-plaint at Abádszalók. In the Kisköre flood-plain, howerer, this association is the dominant one. It occurs in the rather wet areas of the flood-plain. Its dominant tree species are: *Salix alba* et *fragilis* 4, *Populus canadensis* 2. *Fraxinus*

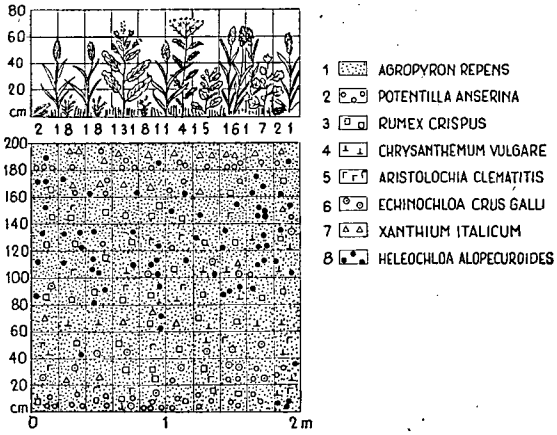

Fig. 3—4

pensylvanica var. *subinterregima* 3. The covering degree of crown stratum is — as a result of the intensive woodfelling and cutting-only 60 percent. Shrub stratum is formed by the younger slender individuals of *Amorpha fruticosa* 2, *Salices* and *Fraxini*. This stratum is here and there made so thick by these and the many *Rubi caesii* 4–5 that walking in the forest may raise serious difficulties. In the association the grass stratum is for med by the real grass-covered areas extending in smaller and larger

stripes and spots, the exuberant spots of high, ruderal, dry stalk-like plants under willows and ashes, and in the water-covered minor spots: *Carex gracilis, Sparganium erectum* and *Gyceria maxima.* Three of these were investigated and are briefly characterized as follows.

(a) *Glycerietum maximae-Sparganium erectum* (HUECK 31) facies.

It occurs in water-covered areas of 50 to 100 square m size, in cavities below willows. Characterizing species: *Sparganiun erectum* 4, *Carex gracilis* 2, *Glyceria maxima* 4, *Eleocharis palustris* 3, *Schoenoplectus lacustris* 1 (+2), *Angelica silvestris* 2.

Table 3. *River-side plant associations on the Abádszalók side of the Tisza*

Name of the plant association	Date of the survey 1 June 1977		Date of the survey 22 September 1977		Site of the survey and percentage of covering
	A-D	K	A-D	K	
I. *Bidentetum, Dichostyli-Gnaphalietum uliginosi* (KOCH) 26/LIBBERT 32 (pp) Its characteristic species:					
Polygonum hydropiper	2–3	III	+–3	III	1.5 km south of the highway bridge of the Tisza at Kisköre, on the lower riverside section 1.5 to 2.5 m from the Water level. Covering: 60 percent
Gnaphalium uliginosum	4–5	V	+–4	IV	
Polygonum lapathifolium	1–2	II	2–3	III	
Polygonum minus	+–2	I	+–1	I	
Chenopodium rubrum	1–2	II	3–4	III	
Potentilla anserina	+–1	I	+–1	I	
Prunella vulgaris	+–1	I	+–2	I	
Xanthium italicum	1–2	II	+–3	II	
Rumex crispus	+1	I	+–1	I	
Bidens tripartitus	2–3	III	2–3	III	
Echinochloa crus-galli	+–2	I	+–3	II	
II. *Rorippo-Agropyretum repentis* (TIMÁR 47)TX 1950 Its characteristic species:					
Agropyron repens	4–5	V	4–5	V	bridgeKálkápolna–Kisújszállás, on the middle and upper sections of the riverside of the Tisza. Covering: 100 percent
Rumex crispus	2–3	III	+–3	III	
Rumex obtusifolius	+–1	I	+–2	I	
Aristolochia clematitis	+–1	I	+–2	I	
Chrysanthemum vulgare	2–3	II	2–3	II	
Potentilla anserina	2–3	III	+–3	III	
Heleochloa alopecuroides	3–4	IV	+–2	II	
Echinochloa crus-galli	1–2	I	+–3	II	
Xanthium italicum	+–2	I	2–(3)	II	
Lycopus exaltatus	+–2	I	2–(3)	II	
Lycopus europaeus	+–1	I	+–1	I	
Prunella vulgaris	+1	I	+–1	I	
Inula britannica	+1	I	+–2	I	
Bidens tripartitus	+–2	II	+–3	III	
Typhoides arundinacea	+–2	II	+–2	II	

Accident species of plant association I. on the river-side: *Carex gracilis Rorippa amphibia, Agrostis alba, Alopecurus pratensis, Inula britannica Phragmites communis, Rhinantus minor, Chenopodium polyspermum.*

Accident species of plant association II on the river-side: *Euphorbia lucida, Chrysanthemum serotinum, Lotus corniculatus, Glycyrrhiza echinata, Centaurea jacea, Trifolium patens, Galium uliginosum, Salix triandra, Amorpha fruticosa, Plantago media* et *major, Dipsacus laciniatus, Mentha piperita.*

(b) *Dichostyli Gnaphalietum uliginosi, Bidentetosum* HORVÁTH 31, SOÓ et TIMÁR 47).

They occur in the wet areas below ashes, in 50 sq. m spots. Characteristic species: *Bidens tripartitus* 4, *Gnaphalium uliginosum* 5, *Carex gracilis* 2, *Prunella vulgaris* 1, *Chenopodium polyspermum* 3, *Iris pseudacorus* 2.

(c) *Caricetum gracilis* (GRAEBNER et HUECK 1931) Tx 37 and its mini-associations which may be considered as almost entirely homogeneous. Its dominant species are: *Carex gracilis* 5, *Eleocharis palustris* 2, *Schoenoplectus lacustris* 1. It forms spots of more sq. m size likewise in the wet areas under the willows. The presence of these mini-associations and species supports very well the observation of the botanist, I. TÓTH, that the presence of *Glyceria maxima, Carex gracilis, Sparganium erectum* makes only possible-owing to the water-covering of lasting and even permanent character- in areas like this the plantation of willow and ash and not of Canadian poplar.

From among the plants of the herb stratum of the willow-poplar forest we are only enumerating the species occuring in the largest masses and the most characteristic species combinations: *Lysimachia vulgaris* 3, *Leucojum aestivum* 2, *Solidago gigantea* 2, *Symphytum officinale* 3, *Glycyrrhiza echinata* 2, *Rubus caesius* 4, *Echinochloa crus-galli* 2, *Iris pseudacorus* 2, *Althaea officinalis* (1) 2, in the downtrodden places and on the way-sides: *Plantago media* 3, *Malva neglecta* et *silvestris* (1) 2. The fringe of the soft-wood forest is closed towards the protecting dam in 2 to 3 m breadth by the thick schrubs of *Amorpha fruticosa* 4. These are crept by *Echinocystis lobata* 3, and *Rubus caesius* 4.

(3) *Carici–Alopecuretum* (Soó 71), half-ruderal grass association.

It is the plant association of the 40 to 50 m broad area extending from the fringe of the soft-wood forest association till the dam (Table 4). Its species number is the largest from among the plant associations investigated in the river-side and flood-plain areas: with 38 species. It is a plant association characteristic of the entire lenght of the 4 km long section which can be considered sporadically as a strong, in its bulk as a half-ruderal grass-association. The cover is, with the exception of ways, everywhere 100 percent. The grassy association is because of its strong weed infestation, often known. Its K index is 80 to 85 percent. The area is utilized by grazing, as well. Its soil properties can be found in Tables 1 and 2. Longer and shorter parts of the association were planted with Canadien poplar saplings about 3 to 4 years ago. These exert, however, no effect on the constant and accident species of the association are published here for giving information (Fig. 5).

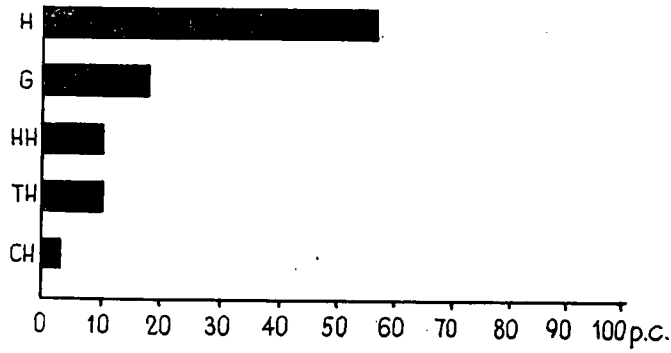

Fig. 5

Table 4. *Herb association of the 40 to 50 m broad area of the Tisza flood-plain at Abádszalók near the protecting dam*

Name of the plant association	Date of the survey 1 June 1977		Date of the survey 22 September 1977		Site of the surwey and percentage of covering
	A–D	K	A–D	K	
Carici-Alopecuretum (Soó 71) Its characteristic species:					
Alopecurus pratensis	3	IV	3	IV	On the 40 to 50 m broad grass area expanding from the edge of the flood-plain associations of soft-wood gallery forest to the protecting dam. Covering 100 percent
Agrostis alba	2	III	+–2	III	
Festuca pratensis	+–1	II	+–2	III	
Festuca arundinacea	+	I	+(1)	I	
Typhoides arundinacea	+–1	I	1	I	
Dactylis glomerata	2	II	2	II	
Phleum pratense	+–1	I	+–1	I	
Poa trivialis (pratensis)	+–2	I	+–1	I	
Carex gracilis	+	I	+	I	
Thypha angustifolia	+	I	+–1	I	
Iris spuria	+	I	+	I	
Glycyrrhiza echinata	+–2	II	+–2	III	
Dipsacus laciniatus	+–2	II	+–2	II	
Chenopodium polyspermum	2	III	+–2	III	
Prunella vulgaris	+–2	II	2	III	
Plantago media	+–2	II	+–2	II	
Symphytum officinale	+–2	II	+–2	II	
Chrysanthemum vulgare	3	III	3	III	
Galium mollugo	+–3	II	+–2	II	
Silene cucubalus	+	I	+–1	II	
Rorippa silvestris	+	I	+	I	
Xanthium italicum	+–1	II	+–2	III	
Echinochloa crus-galli	+–2	I	+–2	II	
Lotus corniculatus	+–1	I	+–1	I	
Mentha pulegium	+—1	I	+—1	I	

Accident species of plant association: *Euphorbia lucida, Centaurea jacea, Althaea officinalis, Solidago virga-aurea, Leucojum aestivum, Iris pseudacorus, Rorippa amphibia, Carex hirta, Juncus articulatus, Angelica silvestris, Agropyron repens, Cirsium canum, Lysimnachia nummularia.*

Macro- and micro-element content of the species of plant associations

The flood-plain soils are — in spite of their several bad properties — rich in mineral nutritive matters. It seemed therefore obvious at the beginning of our investigations that this "plus" would be reflected in the internal content of the plants species of the plant associations in the flood-plain. Similary to our former exercise, the plants were examined in respect of 13 elements, in a double repetition. Of the 13 examined elements 6 are macro-elements (K, Na, Ca, Mg, P, S) and seven micro-elements. (Al, Fe, Mn, Zn, Cu, B, Mo). The values indicating the macro- and micro-element contents of the plants species of the plant associations on the river-side and in the flood-plain were tabulated and characterized with the average of the association. The macro- and micro-element contents of the taxonomically heterogeneous plants species of the single plant associations, resp. the average of the association were compared with the average of the value of the macro- and micro-element contents of the meadow-hay of good quality, investigated similarly in respect of 13 elements. The comparison of the mean values of the acid-grass association was carried out with the average projected on the family of values of the macro- and

micro-elemental contents of the acid-grass species found in the already examined flood-plains of the Tisza. The macro- and micro-element contents of the ligneous plants of the forest association were averaged entirely separated, because we thought that is was not helpful to compare the woody-stalked and soft-stalked plants from the point of view of macro- and microelement content. At the associations of the soft-stalked plants we have considered one or two plants of outstandingly high macro- and micro-element content (e.g. *Malva neglecta,* etc.) as of outstanding values according to Dixon's prove, and left them at the calculation of averages out of consideration.

At the first of the river-side plant associations it is shown by the averages that — with the exception of magnesium — in respect of every macro- and micro-element, the averages exceed the mean values of the meadow-hay of good quality. Strikingly much iron, manganese, zinc and molybdenum accumulates in the bodies of *Polygonum hydropiper, Gnaphalium uliginosum.* Similarly high boron-concentration, zinc and copper content are shown in *Xanthium italicum* as well. It is interesting that in every plant species of the association the K content is high.

The mean values of the species of the second plant association of the river-side — with the expection of manganese — are identical with the mean values of the micro-element content, in case of iron, zinc and sulphur, exceedig the mean values of these many times. There is here, too, a fairly much number of species that excelled in its capacity of accumulating macro- and micro-elements *(Symphytum officinale, Lycopus exaltatus, Rumex obtusifolius* etc*)*.

The mean values of the macro- and micro-element contents of the ruderal, soft-stalked plant species belonging to the forest associations in the flood-plain are similary at the level of mean values of the meadow-hays of good quality but their interestingly contain less K and much more Na than the meadow-hays. There are also here a large number of zinc, manganese, aluminium, iron and molybdenum containing plants. (*Lythrum salicaria* contained 700 mg zinc, 570 mg manganese, Lycopus europaeus contained 400 mg zinc. *Lysimachia vulgaris* contained 240 mg manganense, *Rubus caesius* and *Echinocystis lobata* contained molybdenum in a quantity over 1 mg.

The plant species of the acid-grass associations — as it was to be expected — excelled with their high zinc, manganese and molybdenum values. *Typha latifolia* contained 1800 mg, *Sparganium erectum* 830 mg, *Typha angustifolia* 700 mg manganese, *Schoenoplectus lacustris* 16 mg molybdenum!) The mean values of the plant association esceeded in case of every macro- and micro-element, with the expection of Na, the mean values of the family, ascertained with repeated measurings.

The plant species of the soft-wood forest association are characterized by a low K, Ca and P content and very high zinc, iron, copper and boron concentrations.

Table 5. *Macro- and micro-element content of the plant associations of the Tisza flood-plain area at Abádszalók-Kisköre*

Name of the association	Soil pH	K	Ca	P	Mg	S	Na	Al	Fe	Mn	Zn	Cu	B	Mo
		g/kg						mg/kg						
Average of the meadow hay of good quality	6—7.5	20.0	10.0	2.5	3.0	2.0	0.20	200.0	180.0	80.0	30.0	7.0	20.0	0.5
River-side plant associations I II	6,1													
Polygonum hydropiper L.		27.0	6.8	3.5	3.0	4.0	0.50	261.0	574.0	300.0	196.0	7.8	26.0	9.0
Polygonum lapathifolium L.		20.7	10.6	2.3	–	2.4	0.10	142.0	221.0	16.0	115.0	176.0	–	–
Rumex crispus L.		20.6	6.4	3.6	2.6	2.7	0.34	172.0	208.0	83.0	180.0	11.6	22.0	0.75
Gnaphalim uliginosum L.		40.0	14.4	5.7	2.7	6.0	0.28	660.0	2170.0	98.0	420.0	22.0	42.0	6.60
Xanthium italicum MOR.		22.0	20.6	4.3	3.9	6.7	0.09	150.0	280.0	39.5	174.0	29.9	76.0	0.39
Chenopodium rubrum L.		47.0	8.0	1.7	5.0	2.2	0.28	306.0	1720.0	63.0	46.0	8.3	28.0	0.18
	Average I:	30.0	11.1	3.5	2.9	4.0	0.27	315.0	862.0	99.8	188.5	16.2	32.3	2.82
Agropyron repens P. B.	6.2	18.9	9.0	3.1	–	3.6	0.16	162,0	254.0	30.0	32.0	8.3	5.1	0.48
Plantago major L.		23.1	20.0	4.0	–	5.5	0.08	132.0	220.0	12.0	74.0	15.1	21.0	0.03
Prunella vulgaris L.		17.1	14.0	2.4	–	4.6	0.12	610.0	870.0	52.0	93.0	8.0	37.0	1.08
Rumex obtusifolius L.		34.5	9.2	4.0	–	2.5	0.08	74.0	181.0	20.0	46.0	12.0	28.0	0.51
Lycopus exaltatus L.		23.7	13.4	6.6	–	5.4	0.28	123.0	400.0	45.0	218.0	28.7	32.0	0.27
Aristolochia clematitis L.		27.0	17.2	2.9	–	4.8	0.12	200,0	348.0	35.0	122.0	17.9	44.0	0.25
Chrysanthemum vulgare (L.) BERNH.		27.0	18.0	3.7	–	2.9	0.08	248.0	410.0	90.0	158.0	16.9	36.0	0.31
Chrysanthemum serotinum L.		20.9	12.4	4.4	–	1.9	0.41	394.0	418.0	50.0	112.0	23.9	28.0	0.27
Potentilla anserina L.		23.1	14.0	4.2	–	6.4	0.08	153.0	252.0	40.0	78.0	12.9	44.0	0.60
Bidens tripartitus L.		18.9	11.8	5.4	–	5.7	0.16	222.0	166.0	41.0	160.0	19.2	47.0	0.28
Euphorbia lucida W. et K.		22.5	17.4	3.9	–	5.5	0.16	148.0	215.0	29.0	75.0	7.6	36.0	0.47
Chenopodium polyspermum L.		33.0	7.2	1.7	–	2.8	0.68	370.0	430.0	45.0	46.0	8.5	26.0	0.38
Symphytum officinale L.		53.1	16.8	4.1	–	2.7	2.50	209.0	370.0	22.0	76.0	16.6	42.0	0.17
Xanthium italicum MOR.		18.3	20.2	3.7	–	5.4	0.08	172.0	272.0	19.0	60.0	13.0	65.0	0.27
Heleochloa alupecuroides (PILL. et MITTERP.)		15.4	9.0	2.0	2.1	3.8	0.31	720.0	672.0	69.0	64.0	4.9	6.7	0.86
Setaria lutescens HUBBARD.		24.3	4.2	3.3	3.4	1.8	0.10	510.0	980.0	53.0	124.0	10.3	9.1	0.50
Echinochloa crus-galli P. B.		27.4	9.2	1.3	1.8	4.7	0.80	433.0	483.0	240.0	106.0	3.6	7.7	0.88
	Average II:	25.7	13.2	3.5	2.4	4.1	0.32	286.0	385.0	54.0	100.0	12.5	38.1	0.48
Flood-plain association	5,9													
Rubus caesius L.		10.0	10.5	2.6	4.4	4.1	0.10	241.0	385.0	54.0	62.0	12.2	36.0	1.62
Iris pseudacorus L.		27.6	24.0	1.9	2.5	1.0	0.56	124.0	150.0	19.0	19.0	4.3	22.0	0.13
Iris spuria L.		26.7	20.4	3.3	3.0	2.1	0.08	60.0	142.0	30.0	31.0	7.1	24.o	0.23

Lythrum hyssopifolia L.	9.3	8.8	1.9	2.9	2.9	1.88	221.0	230.0	110.0	890	8.1	20.0	0.35
Lythrum salicaria L.	14.6	22.0	1.9	3.8	5.6	0.44	180.0	420.0	570.0	700.0	6.7	22.0	0.44
Glycyrrhiza echinata L.	12.8	19.1	2.1	2.2	4.2	0.22	157.0	217.0	54.0	28.0	11.8	26.0	0.40
Tiphoides arundinacea DUM.	11.1	4.8	0.9	2.3	6.6	0.08	7.0	110.0	15.0	32.0	5.5	1.0	0.47
Lysimachia vulgaris L.	18.8	13.4	2.3	2.1	4.5	0.42	465.0	530.0	240.0	60.0	7.0	21.0	1.37
Althaea officinalis L.	5.7	28.4	1.7	6.2	7.9	4.80	615.0	517.0	33.0	30.0	7.3	49.0	0.46
Echinochloa crus-galli P. B.	26.7	4.4	3.6	2.8	7.8	0.56	134.0	189.0	24.0	108.0	11.4	9.0	0.53
Echinocystis lobata TORR. et GRAY.	22.0	23.8	3.2	4.4	6.7	0.08	76.0	545.0	75.0	162.0	10.9	47.0	1.04
Lycopus europeaus L.	21.2	19.4	5.8	2.8	7.0	0.44	199.0	462.0	53.0	400.0	12.7	29.0	0.58
Chenopodium polyspermum L.	31.6	10.1	1.9	3.4	4.6	0.74	384.0	430.0	52.0	44.0	10.2	29.0	0.42
Dipsacus laciniatus L.	8.4	12.0	4.1	2.9	2.0	0.08	213.0	183.0	21.0	32.0	9.3	23.0	0.04
Average:	16,7	15.8	2.7	3.3	4.8	0.75	220.0	322.0	97.0	128.0	8.2	27.0	0.58
Acid grassy associations 5.5													
Glyceria maxima HOLMBG.	19.8	3.4	3.1	2.0	3.5	0.16	67.0	149.0	32.0	28.0	6.2	4.0	0.43
Sparganium erectum L.	24.6	13.0	1.5	1.5	4.7	0.16	267.0	294.0	830.0	44.0	3.1	15.0	2.20
Carex grcilis CURT.	26.8	4.6	1.6	1.2	3.7	0.04	161.0	189.0	260.0	88.0	5.0	3.0	0.21
Schoenoplectus lacustris PALLA	7.2	4.2	0.6	0.6	3.6	3.00	254.0	276.0	400.0	20.0	7.5	25.0	16.30
Eleocharis palustris R. et S.	27.4	9.2	1.3	1.8	4.7	0.80	433.0	486.0	240.0	106.0	3.6	8.0	0.88
Typha latifolia L.	16.2	13.4	1.8	1.6	2.4	1.30	285.0	368.0	1800.0	20.0	5.8	11.0	1.60
Typha angustifolia L.	14.5	10.2	2.2	2.1	2.7	0.96	310.0	376.0	700.0	24.0	7.2	10.0	0.76
Sium latifolium L.	33.0	34.0	3.4	3.5	11.5	0.34	535.0	518.0	295.0	208.0	10.6	25.0	2.15
Average:	21.2	11.5	1.9	1.8	4.6	0.80	289.0	332.0	570.0	67.0	6.1	14.0	3.07
Acid grass average of the Tisza flood-plains, family:	18.4	6.7	1.6	1.7	2.5	1.65	150.0	263.0	449.0	45.0	5.5	13.0	1.88
Arborescent plants of forest association 5.6													
Amorphafruticosa L.	10.5	13.2	2.4	1.0	2.3	0.07	152.0	208.0	59.0	37.0	17.6	39.0	1.09
Salix alba et fragilis L.	7.9	11.5	2.1	3.7	3.1	0.08	385.0	150.0	82.0	253.0	8.4	43.0	0.24
Populus canadensis MÖNCH.	9.2	15.2	1.9	3.5	3.5	0.05	91.0	160.0	50.p	301.0	11.7	72.0	0.29
Fraxinus pensylvanica MARSCH.	13.8	14.2	2.8	1.8	3.6	0.16	114.0	350.0	36.0	52.0	37.3	42.0	0.42
Acer pseudoplatanus L.	10.2	14.0	2.6	2.1	2.3	1.88	196.0	357.0	93.0	25.0	7.3	88.0	0.52
Salix triandra L.	8.4	15.0	1.9	3.7	3.8	0.06	306.0	412.0	225.0	340.0	8.6	45.0	0.34
Average:	10.0	13.9	2.3	2.6	3.1	0.38	207.0	273.0	91.0	168.0	15.2	55.0	0.48

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KÖZÉP-TISZAI HULLÁMTEREK NÖVÉNYTÁRSULÁSAI ÉS AZOK MEZŐGAZDASÁGI HASZNOSÍTÁSA

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Kivonat

Szerzők a Középső-Tisza-i tájhoz tartozó Kiskörétől és Abádszalóktól délre, Pusztataksonyig húzódó hullámtéri területeket vizsgálták gazdasági hasznosíthatóságuk, valamint a növénytársulások makro- és mikroelemtartalma szempontjából. A folyópart és a hullámtéri területek talaja közepesen savanyú, friss öntés talaj. Humusztartalom 1—1,42%, a pH 5,3—5,6 (n KCL-ban mérve) között változik.

Szerzők megállapítása szerint a vizsgált területeket elsősorban erdőgazdaságilag hasznosítják és csak 10—12%-nyi gyepes terület az, amely kaszálással, illetve legeltetéssel kerül mezőgazdasági hasznosításra. Az intenzív nemesnyár telepítéssel erősen csökken az eredeti fűz-nyár-kőrises növénytársulás és lényegesen megváltozik az erdőtársulás cserje és gyepszintjének eredeti növénytakarója is. Az egyre gyakrabban felmerülő környezetvédelmi problémák miatt, a területek védetté nyilvánítása halaszthatatlan és indokolt!

A hullámtéri területek növénytársulásai növényfajainak makro- és mikroelemtartalmi vizsgálatai során a szerzők megállapították, hogy a parti és hullámtéri növénytársulások makro- és mikroelemtartalmi átlagértékei minden esetben elérték, sőt felül is múlták a jó minőségű rétiszénák átlagértékeit. Szerzők a növényfajokban 6 makro és 7 mikroelemet vizsgáltak meg kétszeres ismétlésben, tavaszi—őszi aszpektusban).

Biljne zajednice plavnih zona srednjeg toka reke Tise i njihovo korišćenje u poljoprivredi.

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Abstract

Autori su sa stanovišta makro i mikrosastava biljnih zajednica i mogućnosti ekonomskog korišćenja ispitivali plavnu zonu južno od Kisköre i Abádszalók do Pusztataksony, koje područje pripada srednjem toku reke Tise. Tlo plavne zone i obala reke je srednje kiselo. Vrednosti humusa su izmedju 1—1,42%, a pH 5,3—5,6 (merena u n KCL).

Autori su utvrdili da se ispitivano područje u prvom redu koristi u šumskoj privredi, a da livade zahvataju svega 10—12% površine, koja se u pogledu poljoprivrede koristi za proizvodnju sena, odnosno ispašu. Intenzifikacija monokultura topole jako smanjuje autohtone zajednice vrbe-topole-jasena uz istovremenu bitnu promenu i sprata šiblja i zeljastog pokrivača. Zbog sve aktuelnije problematike zaštite životne sredine, zaštita ovih područja je opravdana i ne trpi odlaganje.

Po pitanju makro i mikroelemenata biljnih zajednica autori su ustanovili da su oni u proseku, kako na obalnoj tako i na plavnoj zoni u svim slučajevima dostigli, pa čak i premašili ritske livade u kvalitetu. Autori su na dva navrata (prolećni i jesenji aspekat) utvrdili 6 makro i 7 mikroelementa.

Растительные сообщества пойм средней Тисы и их сельскохозяйственное использование

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Резюме

Авторы проводили исследование пойменных территорий, относящихся к Среден-тисайскому краю, — от Кишкёре и дальше на юг, до Пустатакшоня, — с точки зрения их хозяйственного использования, а также макро- и микроструктуры растительных сообществ. Почва побережья и пойменные территории является среднекислой, свеженасыпной. Содержание гумуса в ней составляет 1—1,42%, а pH = 5,3—5,6 (в^{n} KCL).

Авторами установлено, что исследуемые территории используются в первую очередь как лесные хозяйства, и только 10—12 % дернистой территории используется в сельском хозяйстве на сенокос и как пастбище. Интенсивным насаждением благ.тополя можно значительно снизить преобладающее здесь растительное сообщество ива-тополь-ясень и существенно изменить кустарниковый состав лесных сообществ и первоначальный растительеый покров дёрна. Исходя из всё большей актуальности проблем защиты окружающей среды, объявление этих территорий заповедниками является обусловленным и не терпящим отлагательства!

В ходе анализа макро- и микроэлементарного состава разновидностей растительных сообществ авторы установили, что средние показатели макро- и микроэлементарного состава растительных сообществ побережья и пойм во всех случаях были не ниже, а часто и превышали средние показатели лугового сена хорошего качества. В разновидностях растений авторы исследовали 6 макро- и 7 микроэлементов в двух повторностях (весной и осенью).

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RESEARCH INTO FLORA OF THE SOUTHERN PART OF THE TISA BASIN

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Abstract

In the present paper particular attention is devoted to the distribution, immigration and naturalization of alien species.

Asclepias syriaca L. has been known to be cultivated and to live in wild state in the region investigated since the begining of this century. It is naturalized, common species in the whole region of the southern part of the Tisa Basin.

Echinocystis lobata (MICHX.) TORR. et GRAY had not been recorded for this region until 70's. Nowadays it is very common in the natural vegetation. These two North American species mentioned above escaped from the cultures.

Typha Laxmannii LEPECH. belongs to the group of the adventive plant species from the East. This plant species was recorded for the first time for the southern part of Vojvodina Province around the middle of this decade. It is characterized by evident distribution, in the central parts of the Tisa Basin particularly. In the Cattail vegetation it probably forms sparse indipendent subassociation.

Phacelia tanacetifolia BENTH. This Californian species was recorded for the southern part of the Tisa Basin (nearby Stari Bečej) in 1929. It is melliferous, cultivated plant which lives in wild state in ruderal vegetation. Recently we have found this beautiful adventive ephemerophyte in the surroundings of Zrenjanin and Djala.

Nicandra physaloides (L.) GÄRTN., garden species from Peru, recorded for the region of Banat by Heffel in 1858. In 1929 this species was found in wild state in ruderal vegetation nearby Stari Bečej. We have found this plant species on the similar habitat between Čoka and Ostojićevo since last year, where it is uncommon.

Introduction

Flora of Pannonia and therefore that of the southern part of the Tisa Basin have been investigated relatively in detail since the last century. However, more attention has been devoted to the important topics of phytogeography, i.e. importation, distribution and naturalization of alien species begining with 30's of this century. Among the pioneer works on this problem there are SLAVNIĆ's communications (1943, 1953, 1960 and 1961) concerning Vojvodina Province and adjacent regions. Later, a number of botanists mainly from Vojvodina Province worked in the same field.

Our nonpretentious contribution deals with results of research into alien species, in the southern part of the Tisa Basin and its surroundings, during last three decades. We' 11 analyse in detail the five adventive plant species: *Asclepias syriaca* L., *Echinocystis lobata* (MICHX.) TORR. et GRAY and *Typha Laxmannii* LEPECH, are naturalized in the region investigated and they are in the process of spreading nowadays, whereas Phacelia tanacetifolia Benth. and *Nicandra physaloides* (L.) GÄRTN. are sparsed.

Asclepias syriaca L. was found as cultivated and in wild state in flora of the tribal state of Bač-Bodrog (PRODÀN 1916) at the begining of this century. This species was recorded for the first time from the sothern part of the Tisa Basin as cultivated in gardens in the surroundings of Stari Bečej (KOVÁCS 1929). The same species was recorded for natural vegetation in the forests of While Willow and Almondleaved Willow in the region of the Tisa Basin (SLAVNIĆ 1952). This North American species is widespread in the False Acacia forests as well on sandy soils in the surroundings of Subotica and Kelebija, whereas it occurs sparsed nearby Kanjiža (OBRADOVIĆ 1976). In the Serbian flora it occurs in Vojvodina Province along embankments and at the edges of flooded forests (JOSIFOVIĆ 1973) (Fig. 1).

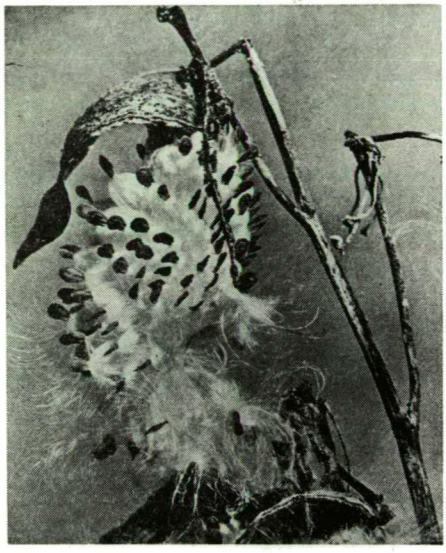

Fig. 1. *Asclepias syriaca* L. — Autumn aspect of opened capsule and seeds.

Recently we have recorded this adventive melifferous species which lives in wild state, this resistant weed (SOÓ 1966) for both sides of the Tisa near the bridge which connects Žabalja and Aradac, namely Zrenjanin. It grows in big populations nearby Žabalj on sandy soils, in depressions covered with the forests of White Poplar, in the vegetation *Fraxino pannonicae-Ulmetum pannonicum* SOÓ subass. *populetosum* SOÓ (SOÓ 1964). In the Banat region we found this species sparsed by the embankments and along the road towards Aradac. We have recorded it nearby Hajdukovo in the surroundings of Horgoš and between Budisava and Šajkaš from similar habitats as well. This species is accompanied by another, more common, neophyte from North America *Echinocystis lobata* (MICHX.) TORR. et GRAY at the locality along the road between Zrenjanin and Čenta.

Echinocystis lobata (MICHX.) TORR. et GRAY

Echinocystis lobata (MICHX.) TORR. et GRAY, annual liana, neophyte, cultivated, in wild state and naturalized was recorded for the first time in Yugoslavia for Slovenia (PETKOVŠEK 1950), and then for Croatia (DEVIDÉ 1956 and DUBRAVEC 1972). Accord-

ing to SLAVNIC's personal communication and our findings, this species is widespread in Sarajevsko Polje in Bosnia. We published data on its occurence in flora of Vojvodina Province (OBRADOVIC 1976) (Fig. 2); we found this plant species by the Tisa river nearby Kneževac, in the surroundings of zabalj, Aradac and Senta where it is common member of the vegetation Calystegion sepium Tx. (SOÓ 1964).

Fig. 2. *Echinocystis lobata* (MICHX.) TORR. et GRAY — Late autumn aspect of fruits.

This species is widespread in the area between the Tisa and the Tamiš rivers as well as along the right tributaries of the Tamiš by the road Zrenjanin–Perlez–Čenta and further in a southward direction. New habitats reveals that this plant species is naturalized in the vegetation *Fraxino pannonicae-Ulmetum* SOÓ and *Salicion triandrae* MÜLLER–GÖRS (SOÓ 1964). Its occurence in Vojvodina Province is cited in "Flora of SR Serbia" (JOSIFOVIC 1977), whereas there is no record in "The Illustrated Weed Flora of Yugoslavia" (ČANAK et *al.* 1978).

Typha Laxmannii LEPECH

This plant species has been recorded recently for Vojvodina Province (BUDAK 1975). It represents the eastern species from rice fields (Fig. 3) which grows in the western and central regions of Asia, in the northern China and in the southeastern Europe (UJVÁROSI 1973). According to the data this adventive plant species occurs in Alfeld by the Tisa between Szolnok and Szeged, while it is in the process of spreading in the southern parts (SOÓ 1973).

All these findings induced us to pay considerable attention to the distribution of *Typha Laxmannii* LEPECH. in the southern part of the Tisa Basin where we recorded

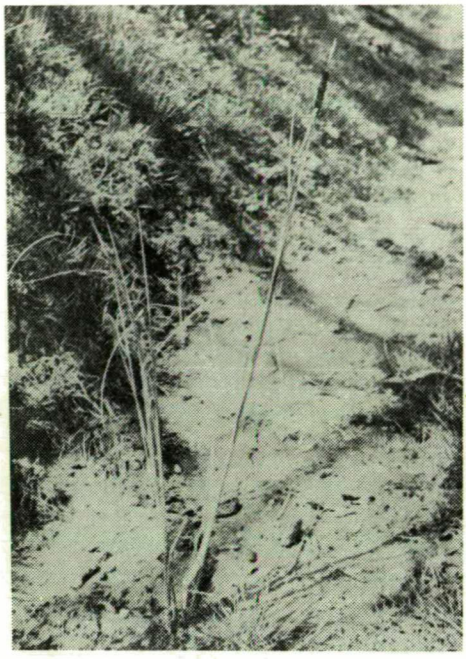

Fig. 3. *Typha Laxmannii* LEPECH. — Plant species from the surroundings of Djala.

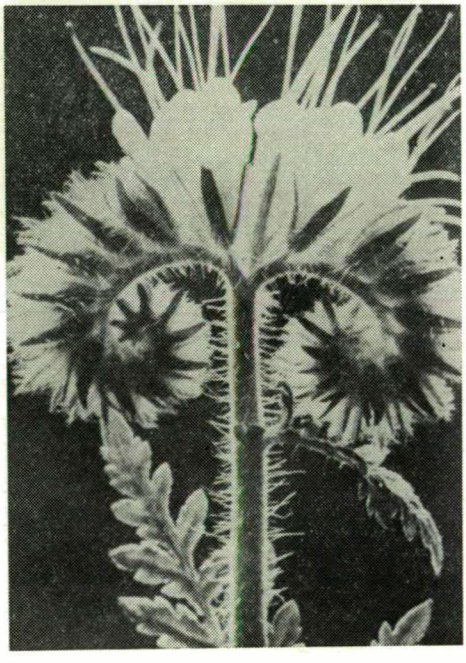

Fig. 4. *Phacelia tanacetifolia* BENTH. — Upper part of stem.

it for the following localities: nearby Bačko Gradište towards Biserno Ostrvo and Bečej it was very common in ditches on sandy soil, on salina nearby Zabalj towards Čurug, in the surroundings of Mol and Ada in canals, nearby Stari Bečej at the ocality towards the new bridge, and according to the information of N. Andrejević* nearby Horgožand Velebit. The localities mentioned above are situated in the region of Bačka by the Tisa river. Among the northernmost localities in the region of Banat there is a record from the surroundings of Djala by BÓZSA.** We have recorded it for the area from Kneževac towards Filić to the Romanian border, in depressions from the Senta bridge to Čoka, between Melenci–Kumane–Novi Bečej.

According to the findings this plant species is spreading nowadays, particularly in the central part of the Tisa Basin in Vojvodina Province. It occurs in the vegetation *Phragmitetum communis* W. KOCH and probably it forms special subassociation *typhetosum laxmannii* UBRIZSY. At the salina nearby Zabalj it is the member of the vegetation *Balboschoenetum maritimi continentale* Soó g. *agrostidetum* BODROGK. (*Scirpetum maritimi* subass. cum "*Aster pannonicus*" SLAVNIC 48). In low and drier canals and in ditches by the roads in the surroundings of Veliko Gradište where this plant species is very common it grows in the vegetation *Pulicaria vulgaris-Mentha pulegium* ass. SLANIĆ (Soó 1964). There are no records of this species either in "Flora of SR Serbia" JOSIFOVIĈ 1976, 1977) or in "The Illustrated Weed Flora of Yugoslavia" (ČANAK et *al.* 1978).

Phacelia tanacetifolia BENTH

First data on the occurence of this species as cultivated garden plant in Vojvodina Province was related to flora of Stari Bečej (KOVÁCS 1929), whereas it was recorded for the first time, as the plant species which lives in wild state in Vojvodina Province, for the surroundings of Rimski Šančevi nearby Novi Sad (SLAVNIĆ 1960). This species from California was cited as a new record from Fruška Gora and the Srem region (OBRADOVIĆ 1961, 1976): there it occurs at fallow on ruderal habitats and by the edge of forest, maybe it is imborn. We had not recorded this species for the region of the Tisa Basin until last year where it was in culture and in wild state in the surroundings of Zrenjanin. According to BÓZSA's information it occured at the northernmost locality nearby Djala where it was sparsed and in wild state by road and on stubble field. There are no records of this species either in "Flora of SR Serbia" (JOSIFOVIC 1974, 1977) or in "The Illustrated Weed Flora of Yugoslavia (ČANAK et *al.* 1978) (Fig. 4).

This North American melliferous plant which is used as feed as well (Soó 1968) belongs to uncommon inhabitants of the region of the Tisa Basin; it has been recorded for the three localities only so far. Taking into consideration that this species is fructiferous under the conditions of this country, more attention to the process of naturalization of this adventive interesting ephemerophyte is of interest.

Nicandra physaloides (L.) GÄRTN

This plant species belongs to the group of neophytes from South America–Peru (Soó 1968). The data from literature are showing that this species is characterized by dispersal growth and that it lives in wild state (JÁVORKA 1925). According to the data on the surroundings of Timisoara in the Banat region, it is cultivated in gardens

* M. S. work by NADA ANDREJEVI

** BÓZSA's personal communication and photograph of *Typha Laxmannii* LEPECH.

whereas it is characterized by spontaneous growth along fields (HEUFFEL 1858). The data from the tribal state of Bač-Bodrog shows that this species was cultivated in wild state in the surroundings of farmsteads (PTODÁN 1916). The first record from the locality in the Tisa Basin (Stari Bečej) was by KOVÁCS (1929); it grows there in gardens and often in wild state. This species may occur in the selfsame region with *Galinsoga parviflora, Silybum Marianum, Artemisia annua* and *Melissa officinalis* as the member of ruderal vegetation. Recently we have found a locality of this species in the Tisa Basin between Čoka and Ostojićevo. It grows by settlements in ruderal vegetation as well; such a vegetation nearby Szeged was described by TIMÁR where *Sisymbrium looselii* and *Erodium ciconium* occur (SOÓ 1964).

Nicandra physaloides (L.) GÄRTN. is uncommon species in the region of the Tisa Basin and judging by the facts it represents adventive ephemerophyte. In the southern part of Vojvodina Province in the Danube Basin where it was found in the vegetation of maize fields and row crop, this species could be classified as epecophyte. There are no records of this species either in "Flora of SR Serbia" (JOSIFOVIĆ 1974, 1977) or in "The Illustrated Weed Flora of Yugoslavia" (ČANAK et al. 1978).

Conclusion

Flora of the southern part of the Tisa Basin and that of others parts of the Pannonian Plain is characterized by expansion and acclimatization of a considerable number of adventive plant species.

We analyzed the five alien species from different world regions. *Asclepias syriaca* L., *Echinocystis lobata* (MICHX.) TORR. et GRAY and *Phacelia tanacetifolia* BENTH. are the North American species; the latter is restricted to the region of California. *Nicandra physaloides* (L.) GÄRTN. is the resident of South America (Peru), while *Typha Laxmanii* LEPECH. represents the eastern species which is widespread in Asia from the western parts to China and in the southeastern Europe.

Asclepias syriaca L. and *Phacelia tanacetifolia* BENTH. are cultivated as melliferous plants. Both live in wild state but their behaviour is different. The former has been known in this region since the begining of this century, it is common in natural vegetation on wet habitats and it is characterized by spreading phase. The latter was found in 30's as a cultural plant or in wild state in ruderal vegetation. The same is true of this species nowadays; it is uncommon adventive ephemerophyte recorded for three localities in the southern part of the Tisa Basin.

Echinocystis lobata (MICHX.) TORR. et GRAY and *Nicandra physaloides* (L.) GÄRTN. escaped from gardens. The former had not been recorded for the southern region of the Tisa Basin until 70's as the species in wild state; nowadays it is widespread and it is the member of the natural vegetation by the Tisa, the Timiš and its tributories. This adventive species is spreading along watercourses. Contrarily, *Nicandra physaloides* (L.) GÄRTN was cited for the region of Banat in last century as garden subspontaneous species. This species, however nowadays is very uncommon one in the southern region of the Tisa Basin because the two localities only have been recorded in ruderal vegetation.

Typha Laxmannii LEPECH., the eastern species from rice fields has been cited for Vojvodina Province recently (1975) where it is very common. This species is characterized by marked expension in the central part of the southern region of the Tisa Basin where it occurs in the Reed vegetation, and probably it forms a special subassociation in a marsh vegetation.

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Florisztikai kutatások a Tisza déli szakaszán

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Kivonat

A „Florisztikai kutatások a Tisza déli szakaszán" című dolgozatban külön figyelmet szentel tünk az idegen növények betelepülésének, terjedésének és meghonosodásának.

Asclepias syriaca L. mint termesztett és elvadult növény a kutatott területen már a század elejétől ismert volt. A Tisza déli részén meghonosodott és elég gyakori.

Echinocystis lobata (MICHX.) TORR. et GRAY-t az említett területen csak a hetvenes években találták, ma már azonban a természetes vegetáció nagyon gyakori tagja. Mindkét faj a kultúrából szökött ki, észak-amerikai származásúak.

A Typha Laxmannii LEPECH. keleti származású adventív növény. Először Vajdaság déli részén észlelték az évtized közepén. Rohamosan terjed főképpen a kutatott terület középső szakaszán. Valószínű, hogy helyenként a gyékényvegetációban szubasszociációt alkot.

Phacelia tanacetifolia BENTH. Kaliforniából származik. A Tisza déli szakaszán először Óbecsénél 1929 találták, mint mézelő kultúrnövényt és elvadultan ruderális növénytársulásokban. Csak újabban gyűjtöttük mi is ezt a szép efemerofita adventív fajt Zrenyanin és Gyála környékén.

Floristička istraživanja u južnom delu Potisja

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Abstract

U radu: „Floristička istraživanja u južnom delu Potisja" posebnu pažnju posvetili smo rasprostranjenju, procesu useljivanja i odomaćivanja biljaka stranog porekla.

Asclepias syriaca L. je kao gajena i podivljala bi.- ka u ispitivanom području poznata od početka ovog veka. U celom južnom Potisju odomaćena je i dosta česta.

Echinocystis lobata (MICHX.) TORR. et GRAY zabeležena je u istom regionu tek sedamdesetih godina, ali je ona danas vrlo čest član prirodne vegetacije. Obe su vrste odbeglice iz kultura i severno američkog porekla.

Typha Laxmannii LEPECH. spada u grupu adventivnih biljaka istočnog porekla. Opisana je prvi put u južnoj Vojvodini polovinom ove decenije. U naglom je širenju naročito u srednjem Potisju ispitivanog područja. U vegetaciji rogoza verovatno izgradjuje mestimično i samostalnu subaso cijaciju.

Phacelia tanacetifolia BENTH., poreklom iz Kalifornije, tridesetih godina prvi put je u južnom Potisju kod Starog Bečeja jabeležena 1929 kao medonosna kulturna i podivljala vrsta u ruderalnoj vegetaciji. Tek u novije vreme našli smo i mi ovu lepu efemerofitnu adventivnu biljku u okolini Zrenjanina i Djale.

Nicandra physaloides (L.) GÄRTN., baštensku biljku iz Perua 1858 pominje Heffel za banatsku floru. Kod Starog Bečeja nadjena je 1929 kao podivljala vrsta u ruderalnoj vegetaciji. Na sličnom taništu i mi smo je zabeležili u poslednje dve godine kao retku biljku izmedju Čoke i Ostojićeva

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HYDROBIOLOGISCHE UNTERSUCHUNGEN DES UNTEREN THEISSLAUFS

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Zusammenfassung

Diese Arbeit umfasst die Ergebnisse der physikalisch-chemischen Untersuchungen, sowie der Zooplanktonzusammensetzung des unteren Theisslaufs im Zeitraum 1975—1977. Hinsichtlich der physikalisch-chemischen Eigenschaften des Wassers kann als gemeinsam für alle drei Untersuchungsjahre ein erhöhter Gehalt an suspendierten Substanzen, an Phenol und Eisen hervorgehoben werden. Der Sauerstoffgehalt im Wasser schwankte um die Mittelwerte von 8,9—9,1 mg/l, bezw. 77% bis 84% Sättigung. Die BSB_5-Mittelwerte betrugen von 2,0—4,6 mg O_2/l.

Der qualitativen Zusammensetzung nach waren im Zooplankton Protozoa, Rotatoria, Cladocera und Copepoda verteten. Insgesamt wurden 65 Taxone festgestellt, davon 11 Protozoa, 40 Rotatoria, 4 Cladocera und 10 Copepoda. Die Artenanzahl varierte saisonmässig. Die niedrigste Artenanzahl wurde im November festgestellt (7), die höchste im August (38). Auch die quantitative Zooplanktonzusammensetzung wies Schwankungen auf. In allen drei Jahren konnte ein Maximum im Sommer festgestellt werden. In den übrigen Perioden unterscheiden sich die Werte nicht viel, jedoch sind die dominante Gruppen unterschiedlich. Im Jahre 1977 kommt auch ein zweites Maximum des Zooplanktons in Herbst vor, das den Werten nach nicht weit hinter den sommerlichen zurückbleibt. Am verschiedenartigsten, und zugleich am zahlreichsten waren die Rotatoria. Die Anzahl der Arten, aber auch der Einzelwesen von Cladocera war sehr gering. Copepoda waren etwas zahlreicher und warem mit verschiedenen Stadien vertreten (Nauolius und Copepodit)

Einleitung

Wie bereits ewähnt, erfolgen die Untersuchungen dieses Wasserlaufs seit vielen Jahren. Wir werden uns indessen nur mit den Ergebnissen aus dem Zeitraum 1975—1977 befassen. Die Untersuchungen wurden an mehreren Profilen vorgenommen, da jedoch die Werte untereinander kaine wesentlichen Abweichungen zeigen, werden die auf Grund der Ergebnisse für die einzelnen Profille ermittelten Werte für den Gesamtflusslauf angegeben. Die physikalich-chemischen Untersuchungen erfassten folgende Parameter: Luft- und Wassertemperatur (°C), Färbung augedrükt in Graden der Pt-Skala, Durchsichtigkeit in mm, pH-Wert, der gelöste Sauerstoff (mg/l), CSV (als $KMnO_4$ und $K_2Cr_2O_7$ Verbrauch) in mg/l, BSB_5 in mg O_2/l, Gehalt an Ammoniak, Nitrit, Nitrat (mg/l), Alkalität (mVal), Gesmt und Karbonathärte (°dH), Gehalt an Chloriden und Sulfaten (mg/l), Abdamfrückstand (mg/l), suspendierte Sunstanzen (mg/l), gesamt gelöste Stoffe (mg/l), Phenolgehalt (mg/l), al. a. Detergentien (mg/l), Ölgehalt ausgedrückt als Ätherextract (mg/l). Ausserdem wurden Daten für den Wasserstand (in cm) und Durchsatzmenge (Q m^3/sec) verzeichnet.

Die chemische Analysen erfolgten nach den von RGV Staaten anerkannten Methoden. Das Meterial für die qualitative Analyse des Zooplanktons wurde mittels Planktonnetz Nr. 22 eingesammelt. Zur quantitativen Analysen wurde die Filtrationsmethode angewandt. Es wurden 10 Lit. Wasser filtriert. Die Werte sind auf 1 Liter berechnet.

Untersuchungsergebnisse

Die Ergebnisse der physikalisch-chemischen Eigenschaften sind in die Tabelle 1. zusammengefasst. Wie aus den Daten hervorgeht, gab es hinsichtlich der Temperaturschwankungen in allen drei Jahren keine wesentlichen Unterschiede. Zumindest weisen die Temperatur-Mittelwerte im längeren Zeitabschnitt keine wesentlichen Schwankungen auf. Auch die Minimal- und Maximalwerte zeigten indessen keine wesentlichen Unterschiede. Nach den Minimaltemperaturen zu urteilen, könnte man eventuel sagen, das Jahr 1976 wäre etwas milder gewesen als die anderen zwei Jahre. Bei den Wassertemperaturen sind diese Unterschiede noch geringer. Die mittleren Unterschiede zwischen Wasser- und Lufttemperatur waren auch nicht hoch, und betrugen 0—2,6 °C, soweit es sich um Mittelwerte handelt. Bei den Minimal- und Maximalwerten sind diese Unterschiede etwas höher, was ja durchaus verständlich ist, zumal die minimalen Wassertemperaturen etwas höher als die minimalen Lufttemperaturen sind, während es bei den Maximaltemperaturen der umgekehrte Fall ist.

Auch die Wasserfarbe zeigte in diesen drei Jahren keine grösseren Schwankungen, während die Durchsichtigkeit unterschiedlich war, Die geringste Durchsichtigkeit konnte im Jahr 1976 festgestell werden, wesentlich schwächer als in 1975 und 1977.

Die Werte für den gelösten Sauerstoff schwankten ebenfalls. Im Jahre 1975 waren diese Werte niedriger als in 1976 und 1977. Die mittlere Sättigung fiel nie unter 75%, während die Minimalwerte sogar bis zu 42% zurückgingen (in 1975). In den anderen zwei Jahren fiel die mittlere Sättigung nicht unter 60%.

Die suspendirten Stoffe wiesen ebenfalls bedeutende Schwankungen auf (6 bis zu 307 mg/l). HöhereWerte für suspendierte Stoffe wurden auch bei früheren Untersuchungen in diesem Theisslauf festgestellt (STANOJEVIĆ MILA, VLASTA PUJIN 1973), desgleichen auch in anderen Theissabschnitten (VÉGVÁRI 1976). Beim Vergleich mit der Menge der suspendierten Stoffe in der Donau, wo sich die Werte zwischen 6—103 mg/l bewegen (STANOJEVIC MILA 1978), können wir feststellen, dass die Theiss im allgemeinen hohe Mengen suspendierter Stoffe kennzeichnet.

Die mittleren BSB_5-Werte betrugen 2,0—4,6 mg/l, während sich die Maximalwerte sogar bis zu 8 mg O_2/l erstrecken, was weit über den zulässigen Werten liegt.

Die Mittelwerte von Phenol waren nicht allzuhoch, doch die ständige Präsenz dieser Substanzen im Wasser, als auch die Maximalwerte, die weitaus die zulässigen überschreiten, weisen auf eine bestimmte Belastung durch diese Stoffe hin.

Auch der Eisengehalt liegt recht hoch, was auch in anderen Theissabschnitten konstatiert wurde (B. TÓTH MÁRIA 1976).

Beim Vergleich der Ergebnisse der vorliegenden Untersuchungen mit früheren (STANOJEVIĆ MILA, VLASTA PUJIN 1973) können wir ersehen, das hinsichtlich des Sauerstoffhaushaltes keine grösseren Veränderungen vorliegen, soweit es sich um die Sättigung handelt, doch kann eine Zunahme des BSB_5 festgestellt werden. Wenn man diese Ergebnisse mit jenem von mittleren Theisslauf (HAMAR et al. 1976) vergleicht, ersieht man, dass der Sauerstoffhaushalt ähnlich gelagert ist, ebenso auch einige andere Parameter, doch ist die Gesamt- und Karbonathärte in diesem Flussabschnitt höher.

Tabelle 1. *Physikalisch-chemische Eigenschaften des unteren Theisslaufs (1975—1977)*

Parameter	1975			1976			1977		
	Mittl.	Min.	Max.	Mittl.	Min.	Max.	Mittl.	Min.	Max.
Lufttemperatur C	13.6	−8	31	15.0	0	29	13.8	−6	30
Wassertemperatur C	13.6	2	24	12.4	1	12	12.9	1	25
F rbung Pt Skala	22	10	38	28	10	65	23	8	38
pH Wert	7.8	7.7	8.2	8.1	7.8	8.4	7.9	8.5	
pH Wert	7.8	7.7	8.2	8.1	7.8	8.4	7.9	7.7	8.5
Gelöste Sauerstoff mg/l	8.2	5.5	19.8	9.1	6.6	12.6	8.9	6.0	11.5
Sauerstoffs ttigung %	77	42	93	84	60	135	82	68	96
CSV ($KMnO_4$) mg O_2 mg/l	7.6	3.9	9.5	4.9	3.1	6.7	5.6	4.3	6.5
CSV ($K_2Cr_2O_7$ mg O_2/l	26.9	16.8	37.2	25.0	17.0	37.7	23.5	16.2	32.2
BSB_5 mg O_2/l	4.6	2.0	7.1	4.2	2.2	8.0	4.1	2.5	6.1
NH_4 mg/l	0.47	0.12	1.85	0.39	0.15	1.6	0.36	0.36	1.25
NO_2 mg/l	0.08	–	0.36	0.10	0.015	0.22	0.075	0.007	0.15
NO_3 mg/l	6.4	3.5	11.0	7.5	4.5	17.0	6.0	3.5	15.0
Alkalit t mval	3.3	2.0	4.0	2.6	1.8	3.3	2.5	2.0	3.4
Gesamth rte odH	11.8	6.0	16.1	9.5	6.5	12.4	9.4	7.3	13.0
Karbonath rte odH	8.4	2.3	12.7	6.9	6.0	8.4	7.1	5.6	9.5
Cl mg/l	61	20	104	51	25	76	43	24	78
SO_4 mg/l	67	42	136	55	36	78	50	32	70
Abdampfrückstand mg/l	508	302	848	454	352	655	391	302	660
Suspendiertestoffe mg/l	59	15	284	86	13	209	77	6	307
Gesamtgelöstestoffe mg/l	452	210	530	367	233	475	314	232	406
Phenole mg/l	0.005		0.016	0.006	0.002	0.012	0.005		0.015
Al. a. Deterg. mg/l	0.118	0.01	0.288	0.071	0.01	0.24	0.069	0.02	0.15
Fe mg/l	0.42		1.1	0.19	0.05	0.52	0.33	0.11	0.55
Ölgehalt als Ather Extract mg/l	6.1		15.6	–	–	–	19.0	9.8	46.7
Vasserstand cm Durchsatzmenge	325	62	545	270	96	582	385	160	739
Durchsatzmenge Q m^3/sec	957	396	1820	939	531	1932	1246	630	2720

Zusammensetzung des Zooplanktons

In der qualitativen Zusammensetzung des Zooplanktons sind folgende Gruppen vertreten: Protozoa, Rotatoria, Cladocera und Copepoda (Tabelle 2). Ingesamt konnten 65 Taxone festgestellt werden. Davon gehören 11 zu den Protozoen, 40 zu den Rotatorien, 4 zu den Cladoceren und 10 zu den Copepoden. Am abwechslungsreichsten waren die Rotatorien, u. zw. im Sommeraspekt. Die Gattung *Brachionus* kommt mit der höchsten Artenanzahl und Varietäten vor (13), danach folgen *Keratella* (6) und *Asplanchna* (4). Die einzelnen Arten kommen durch das ganze Jahr vor, während andere nur an einzelne Aspekte gebunden sind. So finden wir von den Protozoen die Arten *Arcella* und *Difflugia* fast während des ganzen Jahres vor, während andere nur in einzelnen Monaten vorkommen. So konnte *Tintinnopis lacustris* beispielsweise nur im Dezember vorgefunden werden. Die höchste Artenanzahl an Protozoen konnte im März (8) festgestellt werden (Tabelle 3). Allerdings sind hier nur Rhisopoda und Ciliata erfasst worden.

Von den Rotatorien sind *Brachionus calyciflorus* und *Keratella cochlearis* die während des ganzen Jahres vorgefunden werden. Andere Arten der gleichen Genera finden sich indessen nur in einzelnen Monaten vor. So konnte *B. angularis* nur in den Wintermonaten, *B. calyciflorus* v. *dorcas* und *B. c. amphiceros* im Herbst und Winter die übrigen Arten der Gattung *Brachionus* nur in den Sommermonaten festgestellt werden. *Keratella quadrata* und *Polyarthra dolichoptera* wiesen keinerlei saisonmässige Gebundenheit auf. Sie kamen in allen Zeitabschnitten vor, allerdings mit unterschiedlichen Populationsdichten. Der Grossteil der übrigen Rotatorien war auf die Sommermonate beschränkt, *Asplanchna priodonta* und *Rotaria rotatoria* auf die Wintermonate.

Die Anzahl der Cladocera-Arten war gering, insgesamt 4. *Bosmina logirostris* konnte während des ganzen Jahres vorgefunden werden, während die übrigen Arten auf die Frühlingsperiode beschränkt waren, mit ausnahme von *Alonella nana,* die im August festgestellt werden konnte.

Tabelle 2. *Qualitative Zusammensetzung des Zooplanktons des unteren Theisslaufs* (1975–1977)

Arten	Monate											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Protozoa:												
Amoeba vulgaris EHRB.			+	+	+	+						
Arcella vulgaris EHRB.	+	+	+	+	+				+	+	+	
Difflugia limnetica LEV.	+	+	+			+	+	+				
Centropyxis aculeata (EHRB)			+			+						
Chilodonella cucullus (O. F. M.)								+	+			
Paramecium aurelia O. F. M.			+				+		+			
P. bursaria EHRB.		+	+									
P. caudatum EHRB.	+		+									+
Stylonychia mytilus EHRB.				+								
Tintinnopsis lacustris ENTZ												+
Vorticella convalaria L.	+		+									
Rotatoria:												
Anueropsis fissa (GOSSE)							+	+	+			
Asplanchna hericki GUERNE							+	+	+			
A. brightwelli (GOSSE)							+	+	+			

Arten	Monate											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
A. priodonta GOSSE			+						+		+	+
A. sieboldi (LEYDIG)									+		+	+
Brachionus angularis GOSSE	+	+										
Brachionus angularis bidens PLATE									+	+	+	
B. calyciflorus PALL.	+			+	+	+		+	+	+	+	+	+
B. calyciflorus v. *dorcas* (GOSSE)									+	+	+	+	
B. calyciflorus v. *amphiceros* (EHRB)										+	+	+
B. budapestinensis DAD.					+	+	+					
B. diversicornis DAD.					+							
B. falcatus ZACH.							+					
B. leydigii COHN							+	+	+			
B. leydigii rotundus ROUSS.							+	+				
B. quadridentatus cluniorbicularis SKOR								+				
B. rubens EHRB.							+	+	+			
B. urceolaris O. F. M.	+						+	+	+			
Colurella colurus EHRB.								+				
C. uncinata (MÜLLER)								+	+			
Keratella cochlearis GOSSE		+	+	+	+	+	+	+	+	+	+	+	+
K. cochlearis macrocantha LAUTER.						+	+					
K. tecta GOSSE						+		+	+			
K. valga (EHRB)						+	+	+				
K. quadrata O. F. M.	+	+	+		+	+	+	+	+			
K. quadrata monospina EHRB.								+				
Lecane bulla GOSSE								+				
L. luna O. F. M.							+	+				
L. ungulata GOSSE							+	+				
Lepadella acuminata (EHRB)							+	+				
Notholca acuminata (EHRB)			+									
Polyarthra dolichoptera IDELS.		+		+		+		+	+	+		
P. major BURCKARD						+	+					
Rotaria neptunia EHRB.		+									+	+
Rotaria rotatoria PALL.	+											
Synchaeta pectinata EHRB.				+		+		+				
S. stylata WIERZ.								+				
Trichocerca sulcata JENNINGS								+				
T. bicristata (GOSSE)							+					
Trichotria tetractis EHRB.							+					
Cladocera:												
Alona quadrangularis O. F. M.				+								
Alonella nana (BAIRD)								+				
Bosmina longirostris O. F. M.	+	+	+	+	+	+	+	+	+	+		
Chydorus sphaericus O. F. M.				+								
Copepoda:												
Eudiaptomus gracilis G. O. SARS		+	+	+	+	+	+	+	+	+		
Acanthocyclops robustus G. O. SARS	+	+										
Acanthocyclops vernalis FISCHER			+	+	+	+	+	+	+	+		
Diacyclops bicuspidatus CLAUS						+	+	+	+			
Cyclops strenuus FISCHER			+									
C. vicinus ULJANIN	+		+	+	+	+	+	+	+	+	+	+
Macrocyclops albidus JURINE							+	+				
Mesocyclops leuckarti CLAUS			+	+	+	+	+	+	+			
Thermocyclops hyalinus (REHB)						+	+	+				
Eucyclops serrulatus FISCHER					+	+						
Copepodit. Nauplius	+	+	+	+	+	+	+	+	+	+	+	+

Tabelle 3. *Anzahl der in den einzelnen Monaten vertretenen Arten im unteren Theisslauf* (1975—1977)

	Monate											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Protozoa	4	3	8	3	2	3	5	4	4	1	2	3
Rotatoria	3	4	7	7	5	15	20	25	11	4	4	4
Cladocera	–	–	1	2	1	1	1	2	1	1	—	—
Copepoda	2	1	5	4	5	7	7	7	4	3	1	1
Insgesamt Arten:	9	8	21	16	13	26	33	38	20	9	7	8

Copepoda wurden während des ganzen Jahres in verschiedenen ihren Entwicklungstadien *(Nauplius, Copepodit)* vorgefunden. *Eudiaptomus gracilis* und *Cyclops vicinus* sind jene Arten die man das ganze Jahr hindurch antrifft. *Acanthocyclops robustus* und *Cyclops strenuus* fand man in den kälteren Monaten vor. *Acanthocyclops vernalis* und *Mesocyclops leuckarti* sind die Arten, die vom Frühjahr bis zum Herbst vorkommen. *Thermocyclops hyalinus* und *Diacyclops bicuspidatus* sind sommerliche Arten. Diese qualitative Zusammensetzung hat ziemlich viel Ähnlichkeit mit der Zusammensetzung in unseren anderen Gewässern, so auch der Donau, insbesonder hinsichtlich der vetretenen Rotatorien. In der Donau herrscht ebenfalls die Art *Brachionus calyciflorus* vor, und hier ist dies auch der Fall (ŽIVKOVIC ANDJELIJA 1973, NAIDENOV V. 1975, PUJIN VLASTA et al. 1977). Eine ähnliche qualitative Zusammensetzung konnte auch in den anderen Theissabschnitten festgestellt werden (BANCSI 1976).

Die quantitative Vertretenheit der einzelnen Gruppen war unterschiedlich, je nach Jahr, bezw. Saison (Tabelle 4).

Tabelle 4. *Quantitatize Zusammensetzung des Zooplanktons im unteren Theisslauf* (Ind/l 1á75—1977

Jahr	Zooplankton-gruppe	Frühjahr	Sommer	Herbst	Winter
1975	Protozoa	289	447	304	221
	Rotatoria	174	418	85	128
	Cladocera	32	28	16	6
	Copepoda	26	216	10	22
	Insgesamt:	494	1109	415	377
1976	Protozoa	232	367	174	290
	Rotatoria	114	217	183	27
	Cladocera	6	18	19	2
	Copepoda	31	25	8	3
	Insgesamt:	383	627	384	322
1977	Protozoa	172	240	144	127
	Rotatoria	55	312	375	92
	Cladocera	2	15	29	5
	Copepoda	2	85	52	7
	Insgesamt:	231	652	600	148

In allen drei Jahren kann ein Maximum, u. zw. in der Sommerperiode, festgestellt werden. Im Jahr 1977 wurde noch ein weiteres, herbstliches Maximum verzeichnet, das den Werten nach nicht viel hinter dem sommerlichen zurückbleibt. In den

übrigen Zeitabschnitten sind die numerischen Werte ziemlich ähnlich, doch herrschen unterschiedliche Gruppen vor. Im Frühjahr, Herbst und Winter besteht eine Vorherrschaft der Protozoen, ihnen folgen die Rotatorien, obwohl es auch hier jahresabhängige Unterschiede gibt. So konnten wir in der Winterperiode 1975 recht zahlreiche Rotatorien verzeichnen, ebenso auch im Frühjahr 1975 und 1076. Im Jahr 1977 ist die Anzahl der Rotatorien zu dieser Zeit gering. Die Anzahl der Copepoden, insbesonere der Cladoceren, war nicht hoch. Die höchste Copepodenanzahl konnte im Sommer 1975 verzeichent werden, als sie mit 216 Ind/l vertreten waren.

Schlussfolgerungen

Auf Grund der Ergebnisse der Untersuchung der physikalisch-chemischen Eigenschaften, als auch des Zooplanktons des unteren Theisslaufs in den Jahren 1975—1977 konnen folgendes zu schliessen:

Die physikalisch-chemische Eigenschaften des Theissunterlaufs sind diesem ganzen Flussabschnitt ziemlich ausgeglichen.

Der Gehalt an gelösten Sauerstoff hat sich während der letzten einigen Jahren nicht wesentlich verändert. Die Sättigungs-Mittelwerte betrugen 77—84%.

Anders als die Sauerstoffmenge, zeigen die BSB_5-Werte eine steigende Tendenz.

Dieser Theissabschnitt ist durch einen erhöhten Gehalt an suspendierten Stoffen, an Phenol und Eisen gekennzeichnet.

Die Zusammensetzung des Zooplanktons umfasst 65 Taxone, davon 11 Protozoen, 40 Rotatorien, 4 Cladoceren und 10 Copepoden.

Die Artenanzahl schwankt saisonabhängig. Sie ist am höchsten im Sommer (August), 38 Arten, am geringsten im November, 7 Arten.

In der quantitativen Zusammensetzung tritt in allen drei Jahren ein Maximum der Zooplanktonproduktion auf, und zwar in der Sommerperiode. Ein weiteres Maximum kommt nur in einzelnen Jahren und zwar im Herbst vor.

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Hidrobiológiai vizsgálatok a Tisza alsó szakaszán

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Kivonat

A dolgozat az 1975—1977. vizsgálatok fizikai és kémiai eredményeit, valamint a zooplankton összetételét foglalja magába. A víz fizikai és kémiai tulajdonságait, illetőleg kiemelhető a fenol és vastartalom növekedése a háromévi vizsgálati időszak alatt. Az oxigéntartalom 8,2—9,1 mg/l, illetve 77—84% telítettségű középértékekkel ingadozott. Az oxigén biológiai fogyasztása 2,0—4,6 mg/l tett ki.

Összesen 66 taxon zooplankton került elő, mégpedig: 11 Protozoa, 41 Rotatoria, 4 Cladocera és 10 Copepoda. A fajok száma az idénytől függően változott. A fajszám februárban a legkisebb (8) augusztusban a legnagyobb (38). A zooplankton mennyiségi összetétele szintén ingadozott. A háromévi vizsgálatok a nyári hónapok maximumát mutatják. Az év többi időszakában az értékek között nincs lényegesebb különbség, habár a domináns fajok váltakoznak. 1977 őszi időszakában, a nyár maximumhoz hasonló még egy emelkedés jelentkezett. A legváltozatosabb és legnépesebb a Rotatoriák jelenléte. A Cladicerák faj és egyedszáma egyaránt igen alacsony. A Copepodák különböző fejlődési stádiummal (nauplius és kopepodit) valamivel nagyobb számban voltak megfigyelhetők.

Hidrobiološka istraživanja donjeg toka Tise

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Abstract

Rad obuhvata rezultate ispitivanja fizičko hemijskih karaktera, kao i sastav zooplanktona donjeg toka Tise u periodu 1975—1977 godine. U pogledu fizičko hemijskih osobina vode, kao zajedničko za sve tri godine istraživanja, može se istaći povećan sadržaj suspendovanih materija, fenola i gvoždja. Sadržaj kiseonika u vodi je varirao u srednjim vrednostima od 8,2—9,1 mg/l, odn. 77—84% zasićenosti. Srednje vrednosti za BPK_5 iznosile su od 2,0—4,6 mg/l.

U kvalitativnom sastavu zooplanktona bile su zastupljene: Protozoa, Rotatoria, Cladocera i Copepoda. Ukupno je konstatovano 66 taksona, od toga 11 Protozoa, 41 Rotatoria, 4 Cladocera i 10 Copepoda. Broj vrsta je varirao zavisno od sezone. Najmanji broj vrsta je konstatovan februara (8), a najvaći avgusta (38). Kvantitativni sastav zooplanktona takodje je varirao. U sve tri godine mogao se konstatovati jedan maksimum, u letnjem periodu. Uostalim periodima vrednosti se mnogo ne razlikuju, ali su dominantne grupe različite. U 1977 godini javlja se i drugi maksimum zooplanktona u jesenjem periodu, koji po vrednostima ne zaostaje mnogo za letnjim. Rotatoria su bile najraznovrnije, a takodje i najbrojnije. Broj vrsta, a i individua Cladocera bio je veoma mali. Copepoda su bile nešto brojnije i bile su zastupljene različitim stadijumima (nauplius i kopepodit).

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ZOOFLAGELLATES FROM THE WATER STORAGE AREA OF KISKÖRE (HUNGARY)

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(Received 30. June 1978)

Abstract

Author reports on the zooflagellates of the water storage area established on the middle reach of the Tisza river at Kisköre. On the effect of impoundment planktonic species appeared in the area under examination.

Introduction

The impoundment of the middle reach of the Tisza was started in 1973. Impounding has essentially changed the ecological conditions of the river (ÁDÁMOSI et al. 1974, VÉGVÁRI 1976, HAMAR 1976). This is exemplified, among others, by the fact that mostly during summer there was an invasion of planktonic zooflagellates, which were either free-swimming ones, or epiphytic living attached to planktonic algae or to suspended organic detritus.

The zooflagellates were classified according to the system proposed by HONIGBERG (1963), HONIGBERG, BALAMUTH et al. (1964) and on the basis of other more important taxonomical works (BOURRELLY 1957), BÜTSCHLI 1883–1887, CALKINS 1926, DOFLEIN, REICHENOV 1972, 1952, GRASSÉ 1952, HALL 1953, JIROVEC 1953, LEMMERMANN 1914, LEPSI 1965, STARMACH 1968, ZHOUKOV 1971).

Phylum	**Protozoa** GOLDFUSS
Subphylum	**Sarcomastigophora** HONIGBERG et BALAMUTH
Class	**Mastigophora** DIESING
Order	*Rhizomastigida* BÜTSCHLI emend. HONIGBERG
Family	*Helioflagellidae* DOFLEIN–REICHENOW
Genus	*Pteridomonas* PENARD

Pteridomonas pulex PENARD (Fig. 1).

The solitary cells of 9–12×7 μ size are spherical to semispherical. The anterior part bears a flagellum of 2–3 fold body-length. The base of the flagellum is ring-like encircled by fine axopodia. From the basal part of the cell a long attaching stalk projects. Nucleus median, vacuoles of different numbers are located dispersedly in the plasm.

It occurred in the summer plankton of the impounded reach of the Tisza.

Pteridomonas scherffelii LEMMERMANN (Fig. 2).

The cell varies in shape from spherical to semispherical. From the middle of the anterior part, a flagellum of 1–2 fold body-length projects. From the basal part a shorter-longer stalk originates. Thin axopodia project from different parts of the body. Nucleus median, numerous vacuoli in the plasm. The cell is of 6.5–0 μ size.

It occurred during summer in the impounded water of the Tisza as well as in the main canals originating from the impounded reach.

Family *Multiciliidae* POCHE
Genus *Multicilia* CIENKOWSKY

Multicilia palustris PENARD (Fig. 4).

The solitary cell without stalk is naked, polygonal and metabolic. Its diameter is 17–19 μ. The flagella originating from the peaks of the polygon are 32–36 μ long. In the plasm, there are numerous vacuoli and granules. Motion slow, rotating.

It was found in the autumn plankton of the impounded Tisza.

Family *Mastigamoebidae* GOLDSCHMIDT
Genus *Mastigella* Frenzel emend. Goldschmidt

Mastigella sp. (Fig. 3).

The cell measuring 10 μ in diameter is spheroid, the flagellum is of body-length. When creeping on the substrate, lobopodes may project from any part of the cell. Nucleus central, not connected with the flagellar base. It has a contractile vacuole. Plasm is strongly granulated.

It was found during the period of summer water bloom in the marshy place of the future reservoir.

Order *Choanoflagellida* KENT
Family *Monosigidae* KENT
Genus *Codosiga* CLARK

Codosiga florea STOKES? (Fig. 5).

Cells 5–6 μ long, oval with funnel-like collar. Nucleus anterior, contractile vacuole basal. On each occasion only one cell was observed on the thin stalk of 2–3 fold body-length. STOKES (1888) found more cells on one stalk.

It occurred on diatoms or suspended detritus in the summer plankton of the impoundment at Kisköre.

Genus *Salpingoeca* CLARK emend. ELLIS

Salpingoeca brunnea STOKES (Fig. 6).

Lorica of 24×6 μ size, broadly rounded at the bottom narrowing upwards and ending in a slightly overhanging neck. The cell does not fill in the lumen completely, but coincides with the shape of the lorica. The funnel-like collar projects from the lorica. Nucleus central. It has two contractile vacuoli.

The species was found on planktonic diatoms in the summer plankton of the impounded Tisza water at Kisköre.

Table I.

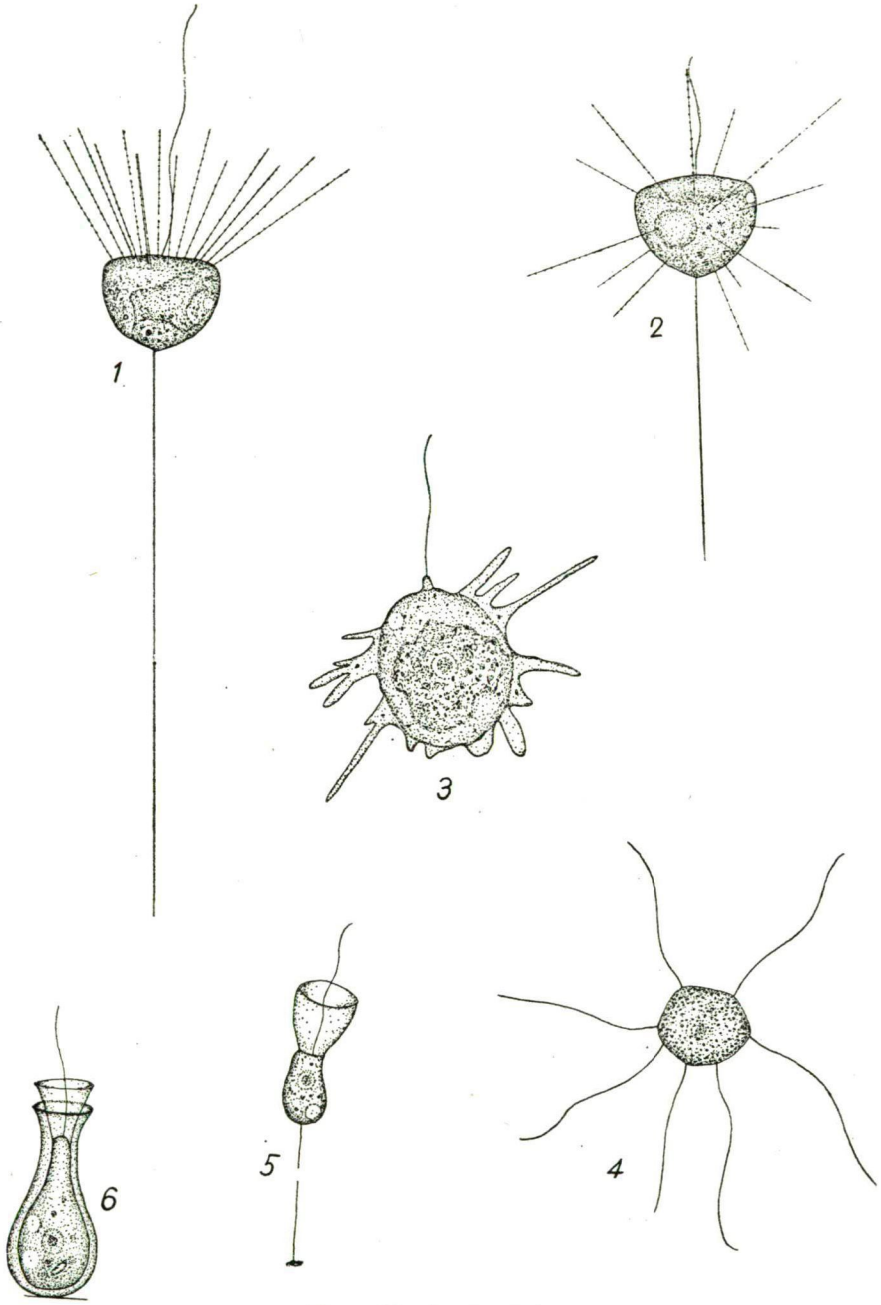

Fig. 1. *Pteridomonas pulex*
Fig. 2. *Pteridomonas scherffelii*
Fig. 3. *Mastigella* sp.
Fig. 4. *Multicilia palustris*
Fig. 5. *Codosiga florea?*
Fig. 6. *Salpingoeca brunnea*

Salpingoeca gracilis CLARK (Fig. 8).

Lorica is long vase-shaped, widened funnel-like in front, spherical in the middle, and ending in a narrowed bottom part. Lorica of 46×8 μ size is hyaline, sessile. The cell is oval, with a continuation of a narrowing neck, which has a funnel-like collar at its peak. The flagellum projects from the lorica. Nucleus central, the cell has one contractile vacuole.

It occurred during autumn in the impounded water of the Tisza at Kisköre.

Salpingoeca bütschlii LEMMARMANN (Fig. 9).

The lorica is vase-shaped, widened funnel-like above, spherical in the middle, and narrowing at the bottom. Lorica hyaline, sessile, of 10×3 μ size. The cell is similar to the lorica in shape, but seldom fills in the lumen. Flagellum of body-length, the collar projects from the lorica. Nucleus central, contractile vacuole basal.

It was found on Cyclotella species during autumn in the impounded Tisza water at Kisköre.

Genus *Diploeca* ELLIS

Diploeca elongata (FOTT) BOURRELLY (Fig. 7, 10).

The species is sessile, the external envelope of the doublewalled lorica is spherical, broadly rounded or cut at the bottom. The internal envelop overreaches the external one, and ends in a thin neck which is widened on top. Lorica yellowish-brown, $10–11 \times$ one, and ends in a thin neck which is widened on top. Lorica yellowish-brown $10–11 \times 5–6$ μ-sized.

It occurred on diatoms in the summer plankton of the impounded Tisza wate at Kisköre.

Diploeca flava (KORSCHIKOV) BOURRELLY (Fig. 11).

The species is sessile, the external envelope of the double-walled lorica is semi-spherical, outside strongly granulated, yellowish-brown. The internal wall coincides-in shape with the external one, then becomes cylindrical and ends in a slightly over-hanging neck. The size of the lorica is 13×10 μ.

It was found attached to filamentous algae in the experimental area impounded with Tisza water.

Order *Bicoecida* HOLANDE
Family *Bicoecidae* KENT
Genus *Bicoeca* (CLARK) STEIN

Bicoeca plantktonica KISSELEV (Fig. 12).

Plantktonic, free-swimming. Lorica conical or wide bell-shaped, colourless or yellow. The anterior end is broader, cylincrical, concave in the middle. There is a verruca at its base. The lorica is ornamented with transversal rings which number 10–15. The size of the lorica is 11–13 μ, the width of the opening is 13–14μ, and in it an oval cell is situated, which is attached to the base by a contractile flagellum. In the anterior part of the cell there is a lip-like extuberance, from the base of which a swimming-flagellum of about 3–4 fold body-length projects. Nucleus central, contractile vacuole is situated in the basal part of the cell.

Frequent in the summer plankton of the impounded Tisza at Kisköre.

Table II.

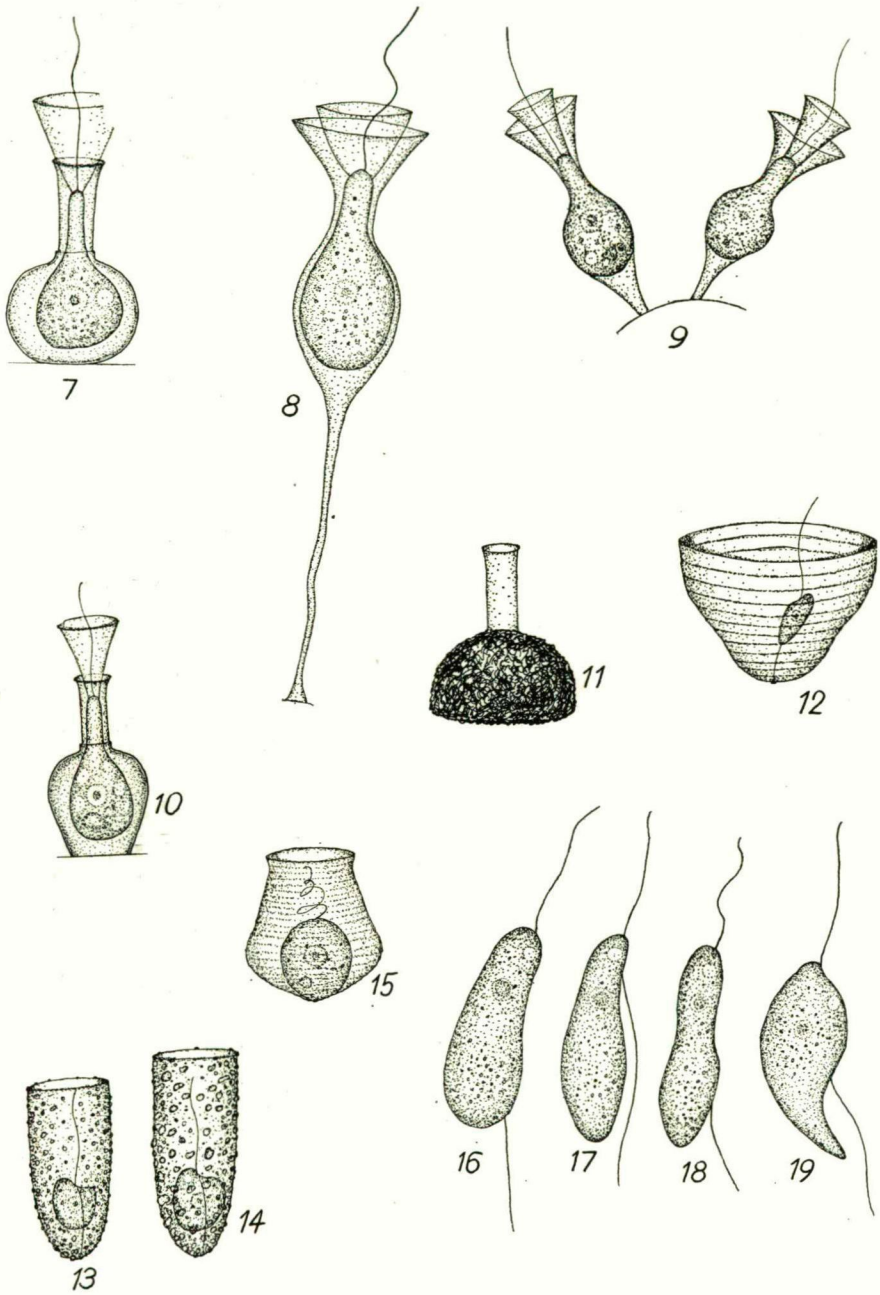

Fig. 7., 10. *Diploeca elongata*
Fig. 8. *Salpingoeca gracilis?*
Fig. 9. *Salpingoeca bütschlii*
Fig. 11. *Diploeca flava*
Fig. 12. *Bicoeca planktonica*
Fig. 13—14. *Bicoeca cylindrica*
Fig. 15. *Bicoeca turrigera*
Fig. 16—19. *Bodo caudatus*

Bicoeca cylindrica (LACKEY) BOURRELLY (Fig. 13–14).

Planktonic species, free-swimming. Lorica cylindrical, cut anteriorly, posteriorly narrowing, rounded. The wall of the lorica is irregularly granulated. In older specimen the wall may thicken. It measures 17–20×7–8 μ.

Cell spherical, situated in the posterior third of the lorica, attached to the bottom. Anteriorly, the swimming-flagellum originates from a slightly widened lip, and seldom projects from the lorica. Periplast thin, nucleus central. There are 1–2 contractile vacuoli.

Frequent species in the impounded Tisza at Kisköre, particularly during summer.

Bicoeca turrigera NYGAARD (Fig. 15).

Planktonic, free-swimming species. Lorica thin, hyaline, urn-shaped, extremely variable. Widened anteriorly, cylindrical or widened in the middle, the posterior part is conical or subconical. At the base of the lorica, there is a verruca. On the lorica, there are transversal rings, due to which the rim of the lorica is finely indented in frontal view. Size of lorica is 16–20×10.5–13.5 μ. The cell is spherical or oval 5–7 μ, pellicula thin, nucleus central. Swimming-flagellum of 2–3 fold body-length, the attaching flagellum contractile.

It occurred in great individual number among suspended and submerged aquatics in the experimental area filled with impounded Tisza water at Kisköre. Diagnosis and place of occurrence of the species is similar to those reported by Nygaard (Nygaard 1949).

Order	*Kinetoplastida* HONIGBERG
Family	*Bodonidae* BÜTSCHLI
Genus	*Bodo* STEIN

Bodo caudatus DUJARDIN (Fig. 16–19).

The cell is naked, elongated spindle-shaped, strongly metabolic, 13–20×5–9 - sized. The anterior part is rounded, the posterior one strongly metabolic, broadly rounded to obliquely tapering. The swimming-flagellum is of one fold body-length, the trailing flagellum of 1,5–2 fold body-length. Nucleus and contractile vacuole are anteriorly situated. The plasm is finely granulated. It moves along with a characteristic nonrotating, trembling motion.

Frequent in wastes and polluted waters, polysaprobic.

It was found in the water of the marshy part of the future reservoir. It occurred in large numbers around destroyed Tardigrada specimens.

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Zooflagelláták a Kiskörei Vízlépcső környékéről (Magyarország)

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Kivonat

A dolgozat a Tisza középső szakaszán létesült Kiskörei Vízlépcső környékének zooflagellátáit mutatja be. A duzzasztás hatására megjelentek a planktonikus fajok a vizsgált szakaszon.

Zooflagellate sa područja brane na Tisi kod Kisköre (Madjarska)

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Abstract

U radu se prikazuju zooflagellate sa područja brane Kisköre sa srednjeg toka reke Tise. Pod uticajem akumulacije pojavile su se planktonske vrste na ispitivanoj deonici.

Зоофлагеллаты из района водного каскада у Кишкёре (Венгрия)

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Резюме

В работе описываются зоофлагеллиты района водного каскада, сооружённого по среднему течению Тисы у Кишкёре. В исследуемый период под влиянием запружения появились планктонические виды.

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SOME NEW ZOOFLAGELLATES FROM HUNGARY

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(Received June 30, 1978)

Abstract

This paper reports on new Zooflagellate species collected in Hungary. The most important hydrochemical properties of their environment are also given. The new *Mastigamoeba, Mastigella, Bicoeca, Amastigomonas* and *Hexamita* species were recovered from various aquatic biotopes, from rivers to waste water purification plants.

Introduction

The microorganisms were studied in living condition under the microscope. They were stained with vital dyes (methylene blue, neutral red) and various methods of fixation and staining were also used (KIRBY 1950). In most cases osmium fixation and carmin acetic acid staining was adopted. Parameters indicative of pollution are summed up in Table 1. The free-living zooflagellates were classified according to the recommendations of HONIGBERG (1963), HONIGBERG, BALMUTH et al. (1964) and on the basis of other taxonomic works (BOURRELLY 1957, BÜTSCHLI 1883–1887, CALKINS 1926, DOFLEIN, REICHENOV 1927, 1952, GRASSÉ 1952, HALL 1953, JIROVEC 1953, LEMMERMANN 1914, LEPSI 1965, STARMACH 1968, ZHOUKOV 1971).

Observations

Phylum	**Protozoa** GOLDFUSS
Subphylum	**Sarcomastigophora** HONIGBERG et BALAMUTH
Class	*Mastigophora* DIESING *(Zooflagellata)*
Order	*Rhizomastigida* BÜTSCHLI emend. HONIGBERG
Family	*Mastigamoebidae* GOLDSCHMIDT
Genus	*Mastigamoeba* SCHULZE 1875

Mastigamoeba polysaprobica spec. nov. (Fig. 1–5)

Cells usually sphaeroid, strongly metabolic, 30–45 μ in diameter. The flagellum is of 2 fold body-length. Periplast thin, smooth and hyalin. In the strongly granulated protoplasm there are 1–8 contractile vacuoles and numerous food vacuoles. There is no or only slight difference between the acto- and endoplasm. Pseudopodia, in

Table I

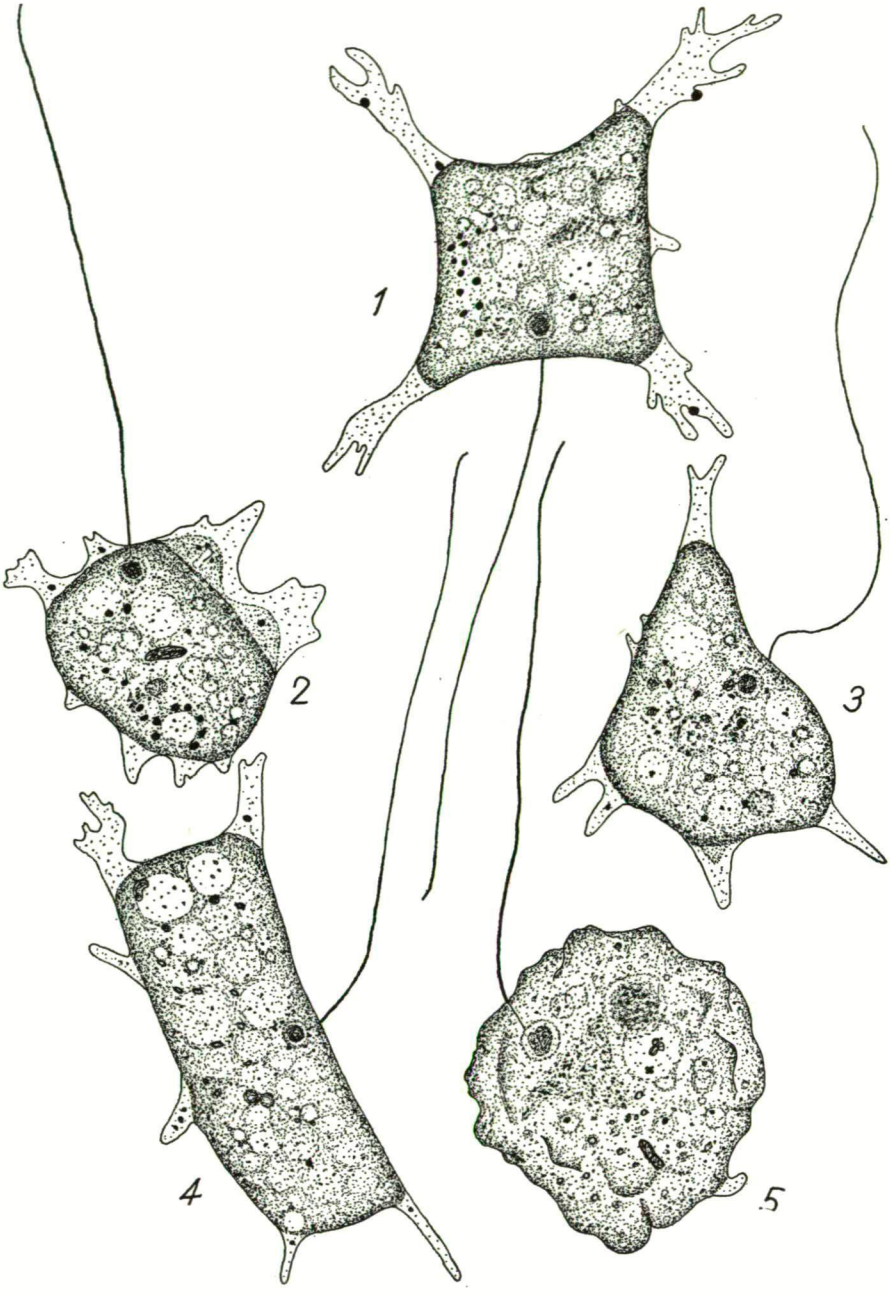

Fig. 1—4. *Mastigamoeba polysaprobica*, 5. *Mastigamoeba polysaprobica*, stained.

the form of lobopodia and filopodia project from different parts of the body. Nucleus near the flagellum, connected with it by a rhizoplast. Motion slow creeping on the substrate. It feeds mainly on bacteria, coprozoic.

It was first found in the purified sewage of the Refrigerator Works, Jászberény, on July 14, 1970, but also occurred in other heavily polluted waters (e.g. sugar-mill wates). In its first place of occurrence it was consistently found together with *Mastigamoeba steinii* KLUG, *Mastigamoeba gigantea* (PROWAZEK) KLUG, *Cercobodo digitalis* (H. MEYER) LEMM., *Cercobodo heimi* HOLLANDE, *Tetramitus pyriformis* KLEBS, *Treptomonas agilis* DUJ. and bacteria. Polysaprobic, which is also indicated by its name.

It is most similar to strains *Mastigamoeba sapropelica* LEPSI and M. sordis LEPSI. It is distinguished from the former by its greater size and different formation of pseudopodia, and from the latter by its swimming form and by the presence of numerous contractile vacuoles (LEPSI 1955, 1965). Its typical form is illustrated in Fig. 2.

Genus *Mastigella* FRENZEL emend. GOLDSCHMIDT 1907

Mastigella parva spec. nov. (Fig. 6–8)

The cell is oval or strongly elongated ovoid. The anterior pole is bluntly tapered, often elongated, the posterior pole is rounded or blunt, ending in a short tip. Laterally the cell may be very undulating. Periplast thin, smooth, hyalin. The protoplasm is sharply differentiated to ecto- and endoplasm. The plasm is spotted by little granules. Contractile vacuole posterior, the nucleus may occur in any part of the cell, it is not in connection with the flagellum of 1.5–2 fold bodylength. Motion floating-bowing or creeping on the substrate. Coprozoic. The cell is small, of 15–20×4–8 μ size, hence its nomination.

It was first found in the purified sewage of the Municipal Sewage Plant of Cegléd on April 21, 1970, together with *Mastigamoeba paramylon* (FRENZEL) LEMM., *Cercobodo longicauda* (STEIN) SEEN, *Bodo caudatus* DUJARDIN, *Tetramitus pyriformis* KLEBS, *Hexamita inflata* DUJARDIN and bacteria. Polysaprobic.

The species most closely resembles *Mastigella limax* SKUJA, but the size of the new species is smaller and its flagellum is longer (LEMMERMANN 1914, LEPSI 1965, SKUJA 1964). Its typical form is illustrated in Fig. 8.

Mastigella maculosa spec. nov. (Fig. 9–11)

The cell is oval or elongated ovoid, anteriorly narrowed and ending in a blunt apex, posteriorly rounded. Size of the cell is 25–30×7–10 μ. Flagellum of 1.5 body-length projects from the tip. Periplast thin, smooth and hyalin. Protoplasm is spotted by granules of various sizes. Nucleus posterior, the 1–2 contractile vacuoles are situated in various parts of the body. Ecto- and endoplasm are not markedly different. Pseudopodia are simple lobopodia, located in different parts of the body. Usually creeps on the substrate, feeds on bacteria. Coprozoic.

It was first found in the purified waste water of the dairy plant of Kisújszállás, on February 19, 1971 together with *Tetramitus pyriformis* KLEBS, *Chilomastix undulata* SKUJA, *Hexamita pusilla* KLEBS and bacteria, but also occurred in waster of other dairy plants and sugar-mills. Polysaprobic. Its name refers to the spottedness of the protoplasm.

It most nearly resembles Mastigella limax, but it is not cylindrical, the flagellum is longer and the size of the cell is smaller. Its typical figure is illustrated in Fig. 9.

Table II

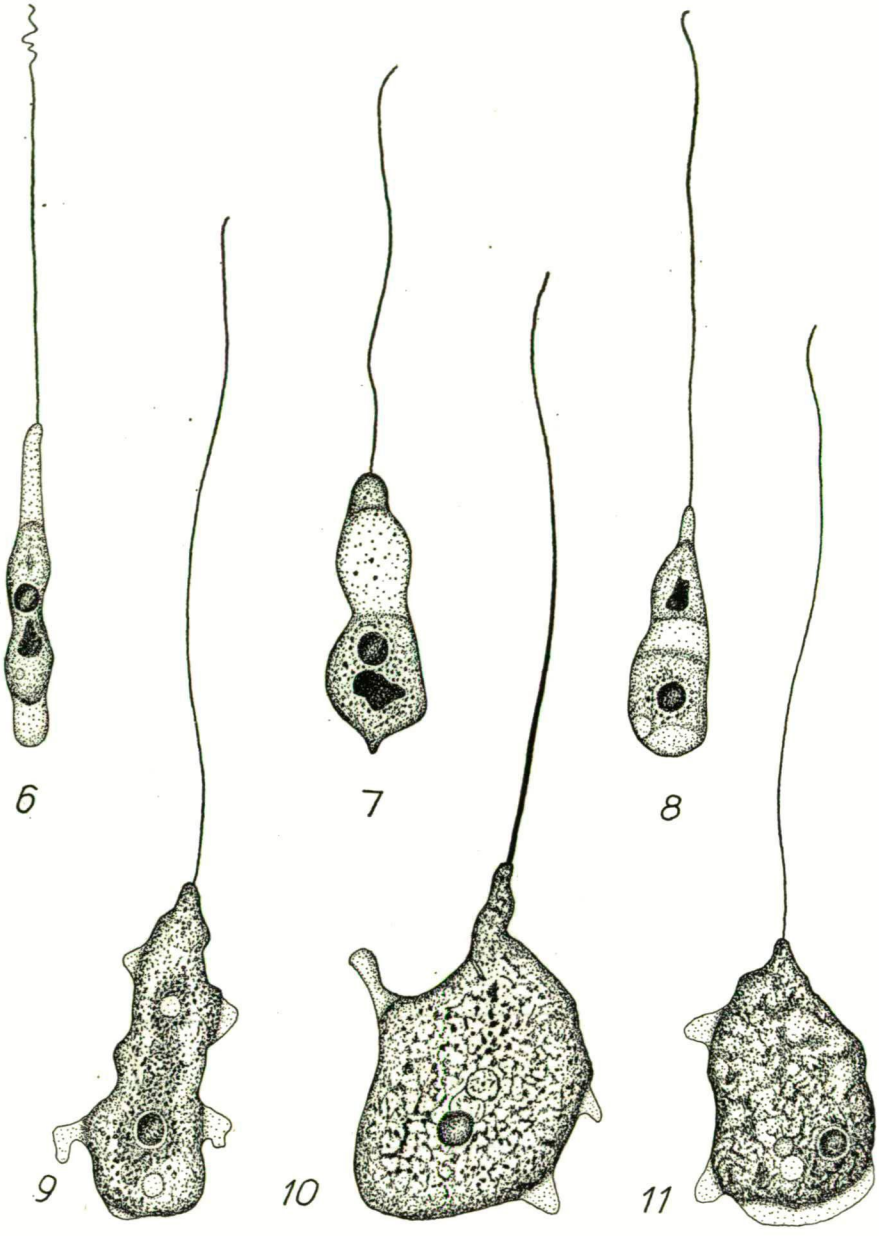

Fig. 6—8. *Mastgella parva*, 5. *Mastigella parva*, stained, 9—10. *Mastigella maculosa* 11. *Mastigella maculosa*, stained.

Mastigella ovata spec. nov. (Fig. 12–16)

In the swimming state the shape of the cell is oval or elongated ovoid. Anteriorly often slightly tapered, posteriorly rounded. Creeping on the substrate, it projects lobopodia at the posterior pole. Its size is 10–18×9–11 μ. Flagellum three-five times longer than the body. Periplast thin, smooth and hyalin. Protoplasm hyalin, there are 1–2 contractile vacuoles and a few food vacuoles situated in different parts of the protoplasm. Nucleus anterior. The plasm is spotted by granules. Motion slow swimming, or creeping movement on the substrate. Coprozoic.

It was first found in the unpurified and purified sewage water of the T. B. Sanatorinm of Újszász, on February 3, 1970, together with *Oicomonas termo* (EHR.) KENT, *Trigonomonas diacra* KLUG, *Trigonomonas inflata* SKUJA, *Streptococcus margaritaceus* SCHROETER, *Sarcina palludosa* SCHROETER and other bacteria. Polysabrobic. Its name refers to its ovoid shape.

It bears closest resemblance to *Mastigella commutans* (H. MEYER) GOLDSCHMIDT, but is distinguished from it by its oval shape and tapering anterior part. Its typical shape is shown in Fig. 14 (LEMMERMANN 1914, LEPSI 1965).

Mastigella compacta spec. nov. (Fig. 23–24)

The cell is oval, may be strongly metabolic. The poles are rounded, anterior part seldom concave. The cell is 20–25×7–14 μ in size, flagellum of 1.5–2 body-length. Periplast thin, hyalin, slightly granulated. Protoplasm is highly granular and spotted. Nucleus anterior, but the rhizoplast is missing. There is a contractile vacuole in the anterior part. Ecto- and endoplasm are not markedly different. Pseudopodia, which are simple lobopodia project at various parts of the body. Its motion is a slow creeping movement on the substrate. Coprozoic.

It was first found in the pure water of the brook Tarna, on February 24, 1970, together with diatoms and *Lagoena obovata* LEMMERMANN, *Bicoeca conica* LEMMERMANN, *Bodo nasutus* SKUJA, *Cercobodo rhynchophorus* SKUJA, *Cercobodo chromatiophagus* SKUJA, *Hexamita tremelloranis* SKUJA, *Stephanocodon socialis* (LAUTER.) PASCHER, *Desmarella brachycalyx* SKUJA. Beta-mesosaprobic, its name refers to its shape.

It is similar to the species *Mastigella commutans* (H. MEYER) GOLDSCHMIDT, although its shape is strongly metabolic and its flagellum is shorter (LEMMERMANN 1914, LEPSI 1965). Its typical form is illustrated in Fig. 23.

Order *Kinetoplastida* HONIGBERG
Suborder *Bodonina* HOLLANDE
Family *Bodonidae* BÜTSCHLI
Subfamily *Bodoninae* BÜTSCHLI
Genus *Amastigomonas* DE SAEDELEER 1931

Amastigomonas borokiensis spec. nov. (Fig. 17–21)
(syn.: *Amastigomonas* sp. ZHOUKOV 1971, Table. IV. Fig. 2a–g)

The naked cell devoid of flagellum is anteriorly narrowing and ends in a curved proboscis of one third body-length. Its posterior part is narrowed, little rounded or slightly tapering. At the posterior pole, it may project a thin, simple pseudopodium. Size 5–9×3–4 μ. Periplast thin and hyalin. Protoplasm is spotted in different degrees for the presence of tiny granules. In the posterior half, there is one contractile vacuole. Nucleus anterior, connected with the basal body by the rhizoplast. At the basel body

Table III

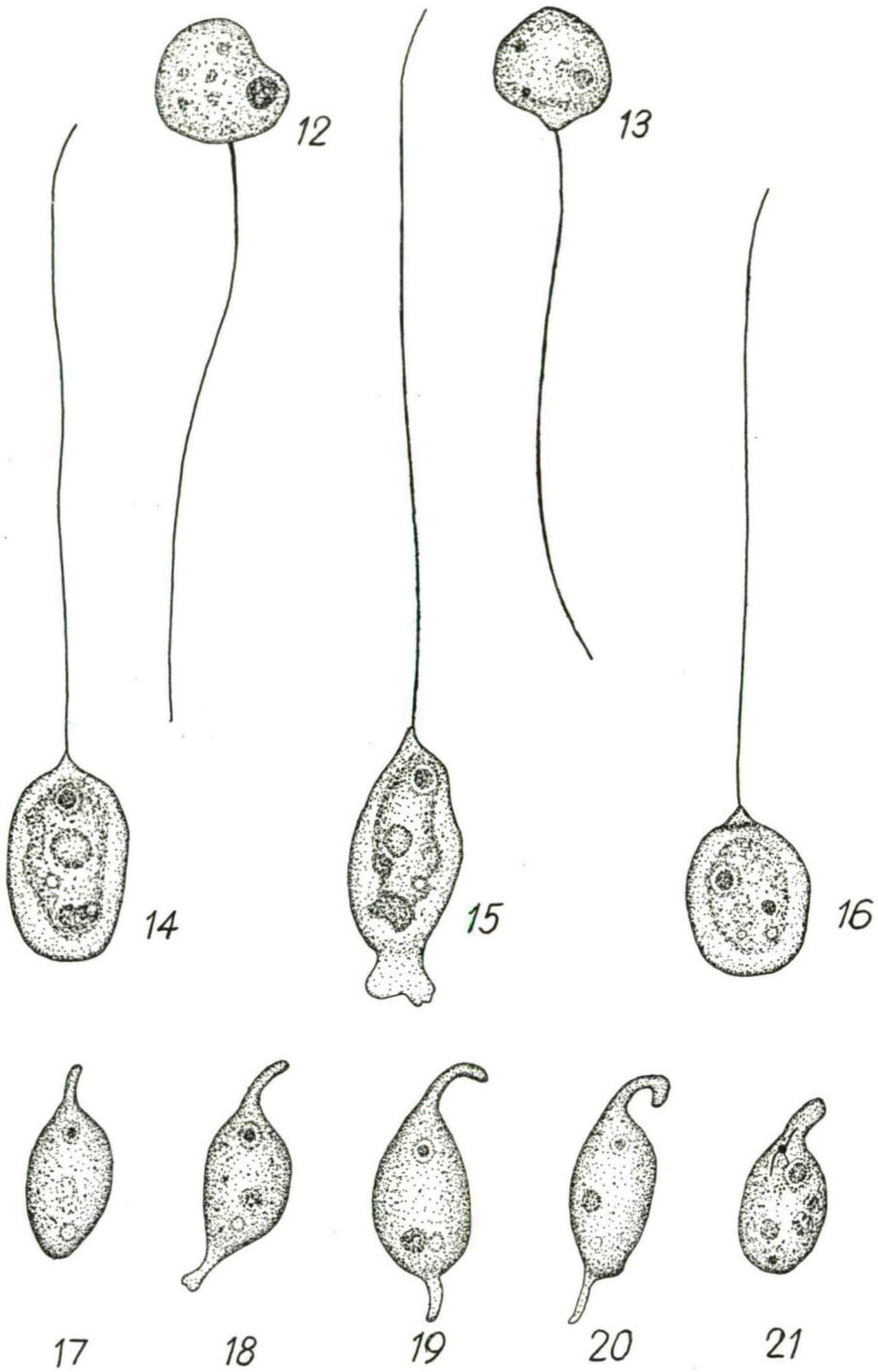

Fig. 12—13. *Mastigella ovata*, stained, 14—16. *Mastigella ovata*, 17—20. *Amastigomonas borokiensis*, stained.

short aborted flagellae project in the direction of the proboscis and backwards (Fig. 21). Motion slow, bowing or creeping on the substrate.

This organism was first mentioned by Zhoukov (1971) from Rybinsk reservoir, and he named it Amastigomonas sp. In Hungary, it occurred in the sediment of the fish-ponds of Bánhalma (at a water depth of 1 m). On May 27, 1972 it was found in pond No. 8 together with *Mastigamoeba torulosa* Skuja, *Mastigamoeba lacustris* Penard, *Mastigella simplex* Skuja, *Mastigella caput-medusae* Klug, *Mastigamoeba socialis* Penard, *Bodo parvus* Naegler, *Cercobodo minutus* Valkanov, *Trigonomonas aechme* Skuja. It is assumedly an alpha-mesosaprobic organism. The sediment and the water above it in the fish-pond has not been analysed chemically.

It is distinguished from the species *Amastigomonas debruynei* de Saedeleer by its oval shape and relatively smaller proboscis (Grassé 1952, Zhoukov 1971). Its typical form is shown in Fig. 17. The name of this organism refers tothe Hydrobiological Center of Borok at Rybinsk reservoir.

Family *Cercobodonidae* Hollande
Genus *Cercobodo* Krassiltschik 1886

Cercobodo robustus spec. nov. (Fig. 25–26, 40)

The cell is cylindrical, strongly metabolic. Its anterior part is rounded, devoid of flagellar depression, posteriorly tapering into a thin apex. The body often looses its cylindrical shape, becomes widened, assuming a spindle or oval shape.

Pseudopodia are formed in the posterior part, they may be thin and long, or thick and fanning out. Flagella of about body length originate from the apex. The swimming-flagellum is somewhat shorter. Periplast is thin, smooth and hyalin. Protoplasm finely granulated, nucleus and contractile vacuole anterior. Motion fast vibrating or creeping on the substrate. Saprophytic, coprozoic. The size of the cell is 26–31×3–9 μ.

It was found on the first occasion in the waste water of BVM Works, in Szolnok, on March 29, 1971 together with *Trepomonas steinii* Klebs, *Cercobodo longicauda* (Stein) Senn, *Hexamita fusiformis* Klebs and bacteria. It was also found in other sewages. Polysaprobic, its name refers to its shape and size.

The new species shows a close similarity to *Cercobodo draco* Skuja, although it is distinguished from it by its size, the lack of subapical flagellar depression and the form of pseudopodium formation (Lemmermann 1914, Skuja 1946–48, Starmach 1968). Its typical figure is shown in Fig. 26.

Cercobodo venticosus spec. nnv. (Fig. 33—34, 36).

The cell is oval or elongated spindle shaped, with an upper part consisting of a narrowing, long neck, from the apex of which a swimming-flagellum of 2 fold body-length projects forward, and a trailing flagellum of 1.5 fold body-length projects backwards. The bottom is rounded or ends in a blunt apex. Pseudopodia, which are simple lobopodia, project from the posterior pole. Periplast thin, smooth and hyalin. Protoplast finely granulated. Nucleus and contractile vacuole median. When swimming, its motion is wobbling, when creeping on the substrate, it projects pseudopodia. Saprophytic coprozoic. Size 19–25×4–7 μ.

It was found at first in the polluted water of the brook Körösér below Nagykőrös, on October 14, 1969, together with *Heterochromas vulgaris* (Cienk.) Pascher, *Cercobodo draco* Skuja, *Cercobodo ellipticus* Valkanov, *Hexamita angusta* (Klebs) Lemmermann, *Vorticella microstoma* Ehrenberg and bacteria. Polysaprobic. It was named after its shape.

Table IV

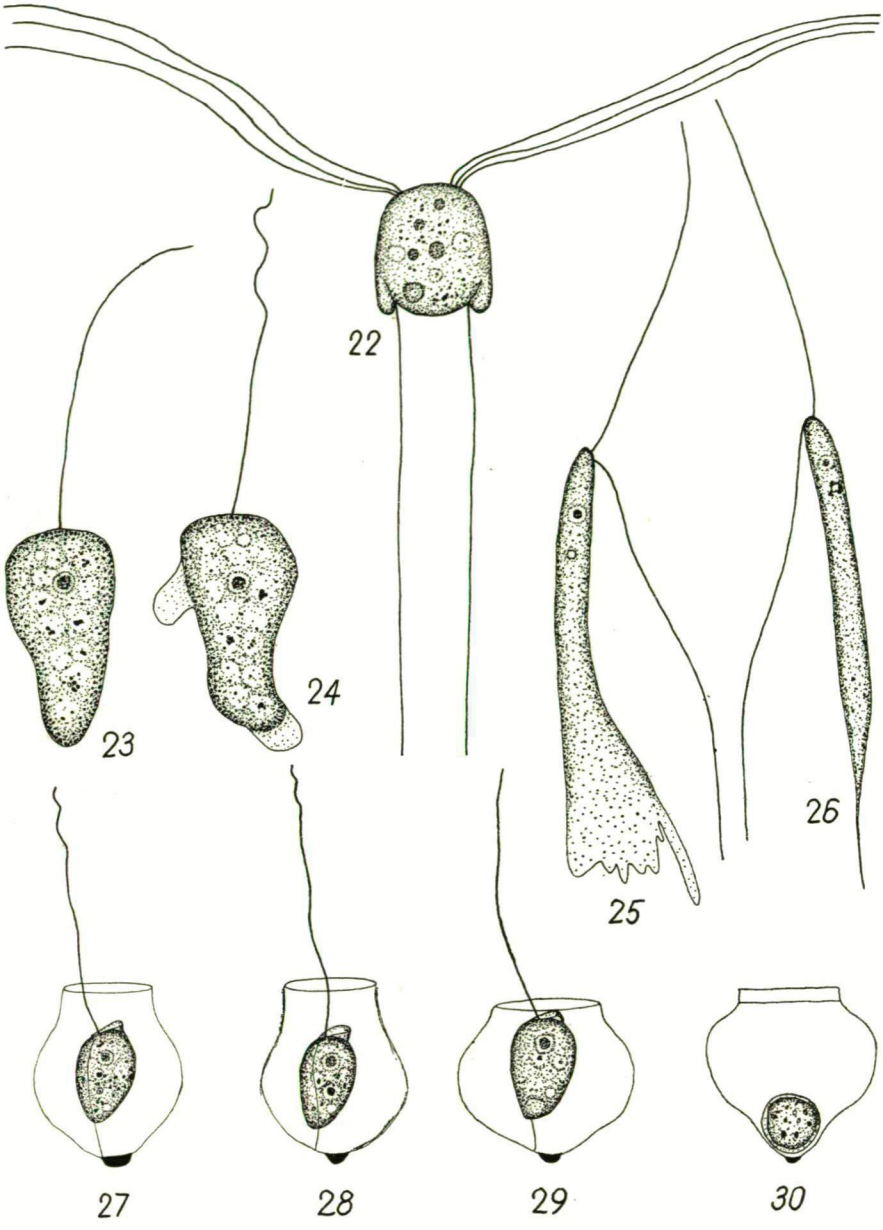

Fig. 22. *Hexamita longifila* ,23—24. *Mastigella compacta*, 25—26. *Cercobodo robustus*
27 | 29. *Bicoeca starmachi*, 30. *Bicoeca starmachi*, cysta

It is similar to *Cercobodo draco* SKUJA and *C. acutus* SKUJA, but the persistent oval shape of the posterior part distinguishes it from these species (LEMMERMANN 1914, SKUJA 1946–48, STARMACH 1968). Its typical form is shown in Fig. 33.

Cercobodo lagoenaris spec. nov. (Fig. 37–39)

In swimming state it is elongated ovoid, metabolic, rounded at the bottom, on the top narrowing and ending in a neck. When creeping on the substrate it often assumes a spherical shape. The size of the cell is 11–19×5–8 μ. Flagella of about 1.5 fold bodylength originate from the apex. The swimming-flagellum is somewhat shorter. The trailing flagellum is occasionally attached to the anterior part of the body, and as a consequence of the motion of the flagellum, the periplast becomes undulate, but does not form a membrane. Periplast thin, smooth and hyalin. The protoplasm is spotted by granules of different sizes. Nucleus median. The contractile vacuole is situated in different parts of the body. Pseudopodia project from the posterior part. These are lobopodia. Motion wobbling-bowing or creeping. Saprophytic, corpzoic.

It was found on the first occasion in domestic sewage at Mezőtúr, in the company of *Bodo caudatus* DUJARDIN, *Cercobodo longicauda* (STEIN) SEENN, *Pleuromonas nasuta* SKUJA and bacteria. Polysaprobic, named after its bottle shape.

It perhaps best resembles certain forms of *Cercobodo cometa* HOLLANDE (GRASSÉ 1952, Fig. 535 d), but differs from them in size, in the formation of pseudopodia and the figure of its anterior part. Its typical form is shown in Fig. 39.

Order	*Bicoecida* HOLLANDE
Family	*Bicoecidae* KENT
Genus	*Bicoeca* (J. CLARK) STEIN 1978.

Bicoeca starmachi spec. nov. (Fig. 27–30)

Planktonic, free-swimming species. Lorica urn-shaped, most variable, in front neck-like projecting. Median part widened and different in shape. Posterior part attenuatedly rounded or broadly rounded. At the posterior pole, there is always a great verruca. The membrane of the lorica is thin, smooth and hyalin. The oval cell is transversely cut on the top, peristome low and unilateral. At the bottom the cell is tapering or rounded. The swimming-flagellum is of 3 fold body-length, the other flagellum (flagello postico) is rigid and attaches the cell to the base of the lorica. Periplast thin, smooth and hyalin. Protoplasm spotted, the single contractile vacuole basal, nucleus central. Its motion is slowly rotating. Lorica is of 9–13×8–11 μ size, the cell of 5–7×3.5 μ and the pore of of 3.5–4.5 μ size.

It was found in the stagnant water dead-arm of the Tisza, named "Borzanat", together with *Stokesiella epipyxis* PASCHER, *Stokesiella acuminata* LEMMERMANN. *Stokesiella dissimilis* (STOKES) LEMMERMANN, *Stokesiella longipes* (STOKES) LEMMER, MANN, *Monosiga ovata* KENT, *Monosiga fusiformis* KENT, *Monosiga angustata* KENT, *Desmarella sphaeroidea* (SCHILLER) BOURRELLY and epiphytic algae, on July 20, 1969- Beta-mesosaprobic. Named in honour of Professor KAROL STARMACH.

The appearance of this species best resembles the species *Bicoeca turrigera* NYGAARD and *Bicoeca urceolata* FOTT, although it differes from the former by its thinner and smooth lorica, and from the latter by its different shape. Compared to both of them, the lorica is always colourless, the pore is occasionally ringed and there is a verruca at the bottom (FOTT 1944, NYGAARD 1949, STARMACH 1968).

Bicoeca szabadosi spec. nov. (Fig. 48–50)

Plaktonic, free-swimming species. Lorica thin, hyalin and naked. Cylindrical, broadly rounded posteriorly. The anterior part is occasionally funnel-like widened. The cell does not fill in the lumen, it is oval, at the top obliquely cut, at the bottom rounded. Peristome low, occasionally not visible. The swimming-flagellum is of 2–3 fold body-length. Periplast thin, translucent. In the protoplasm the nucleus centra, there are 1–2 contractile vacuoles. The cell is attached to the basal part of the lorica by means of the second flagellum. It moves along with slow rotating motion. Size of the lorica is 20×7–8 μ, that of cell 7–8×5–6 μ.

It was found for the first time in the main canal of Nagykunság in front of the impoundment at Kisköre on 1973 but also often occurred in the impounded reach of the Tisza at Kisköre, together with planktonic algae. Alpha-beta-mesosaprobic.

It was named in honour of the protistologist Margit Szabados.

It best resembles the species *Bicoeca cylindrica* (LACKEY) BOURRELLY, although the size of its lorica and the fact, that its lorica is naked and rounded at the bottom separates it from the above species. *Bicoeca cylindrica* also occurred in the same place, thus opportunity was given for their comparison (BOURRELLY et GEORGES 1953, WILLÉN 1963, STARMACH 1968). Its typical form is shown in Fig. 48.

Order	*Polymastigida* BLOCHMANN emend. REICHENOW
Suborder	*Diplomonadina* CALKINS
Family	*Hexamitidae* KENT
Genus	*Hexamita* DUJARDIN 1838

Hexamita longifila spec. nov. (Fig. 22)

The cell is spherical oval, occasionally a little flattened, measuring 13–15 μ in diameter. Posteriorly sometimes broadly rounded, with striae reaching to two third of body-length, which produce ear-like formations on both sides. These seldom outreach the cell. Flagella of 3–4 fold body-length, the swimming-flagella project from both sides of the front part, and the trailing flagella from the split of the posterior part. Periplast thin, smooth and hyalin. Protoplasm is spotted by granules of various sizes. In the plasm numerous food vacuoles and 1–4 contractile vacuoles are situated dispersedly. Motion slow, floating.

It occurred in the raw waste water of the flour-milling works at Törökszentmiklós on May 12, 1970, together with *Mastigamoeba radiata* KLUG, *Mastigella polyvacuolata* (MORROFF) GOLDSCHMIDT, *Trepomonas agilis* DUJARDIN, *Hexamita crassa* KLEBS and bacteria. Polysaprobic, named after its characteristically long flagella.

It is similar to the species *Hexamita pusilla* KLEBS, but there are some features at variance with this species, as the longer flagellum, the situation of the split, the motion, which is not rotating. Fig. 22 shows its typical form.

Hexamita skujai spec. nov (Fig. 31—32, 35).

Its fast swimming form is elongated oval, the anterior part is rounded, the posterior one the same or slightly tapering. Cell size is 13–15×6–7 μ. The swimming-flagella are of body-length and project from both sides of the anterior part. The trailing flagella are of body-length and originate from the posterior pole which is devoid of a split. Between the two flagella there is a thinner-thicker plasma membrane.

Table V

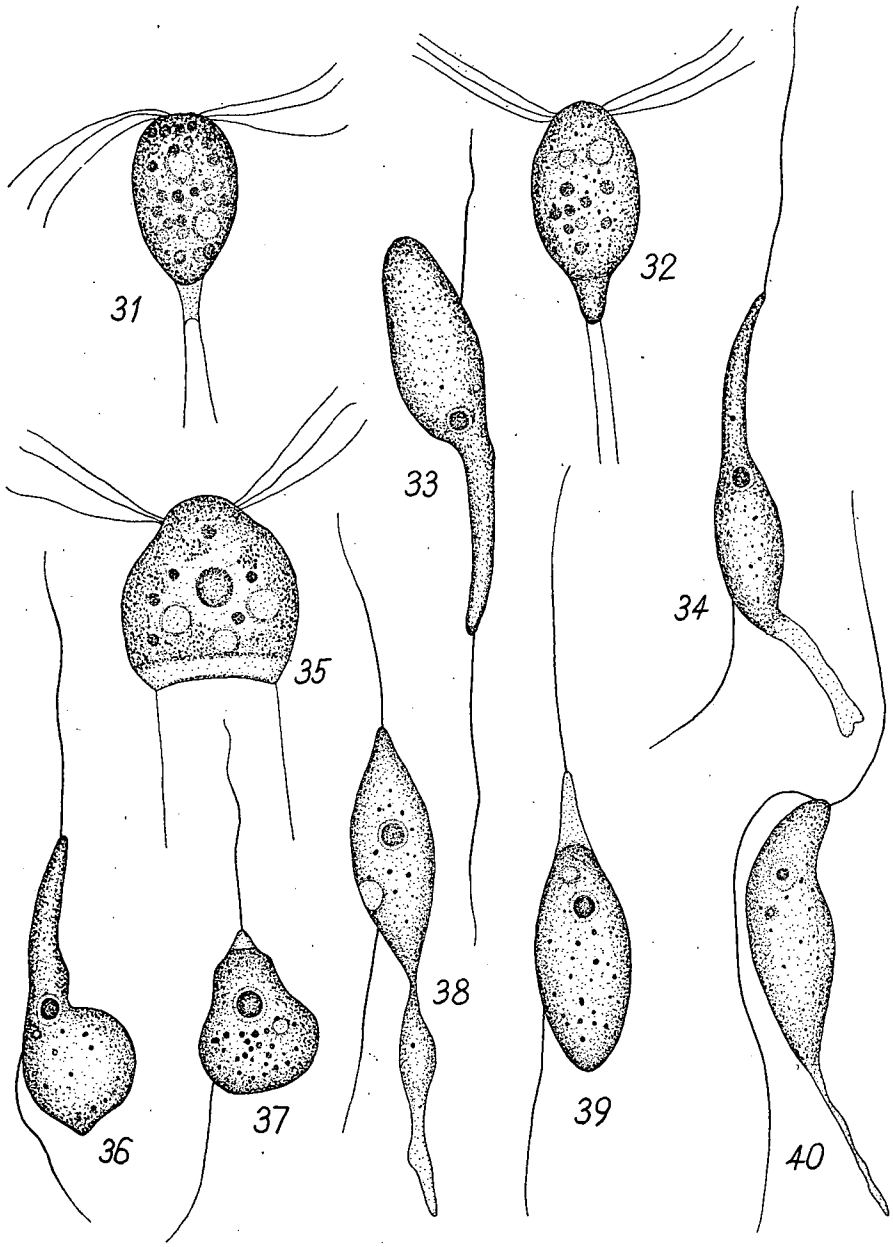

Fig. 31—32. 35. *Hexamita skujai*, 33—34, 36. *Cercobodo ventricosus*, 37. *Cercobodo* lagoenaris, 40. *Cercobodo robustus*.

The floating or slowly rotating form is swollen anteriorly, posteriorly broad, dorsoventrally flattened. Its size is 13–16×11–13 μ. The posterior part is strongly metabolic.

Periplast thin, smooth and hyalin. Protoplasm seldom strongly granulated, not translucent. 2–3 contractile vacuoles are situated in different parts of the plasm.

It was found for the first time in the raw waste water of the piggery at Tiszaszentimre on August 28, 1970, together with *Mastigamoeba gigantea* (PROWAZEK) KLUG, *Tetramitus pyriformis* KLEBS, *Trepomonas agilis* DUJARDIN and bacteria. It is frequent in other wastes, too. Polysaprobic. Named in honour of Professor H. SKUJA.

It is similar to *Hexamita fusiformis* KLEBS and *Hexamita fissa* KLEBS, but its poles are rounded and the cells are splitless. It is metabolic. Its typical form is shown in Fig. 31.

Hexamita hollandei spec. nov. (Fig. 41–43)

The tiny cell, 5–6 μ in diameter, is generally spherical, occasionally oval. Flagella are of body-length, the swimming-flagella project from both sides of the anterior part, the trailing flagella project on both sides of the posterior pole from the splitless body. Periplast thin, smooth and hyalin. Protoplasm granulated in varying degrees. In the plasm 1–4 contractile vacuoles occur dispersedly. Motion rotating or floating.

It was often found in the polluted water of the Körösér brook (the first time on December 10, 1971), together with *Oscillatoria chlorina* (KÜTZ.) GOM., *Bodo cruzi* HARTMANN et CHAGAS, *Bodo putrinus* (STOKES) LEMMERMANN, *Trepomonas agilis* DUJARDIN, *Hexamita fissa* KLEBS and bacteria. Polysaprobic. Named in honour of the French protistologist A. HOLLANDE.

The new species best resembles the species *Hexamita pusilla* KLEBS, but its measurements, the lack of striae, and the fact that the trailing flagella originate from the posterior pole, separates it from this species. Its typical form is shown in Fig. 41.

Hexamita gracilima spec. nov. (Fig. 44–45)

The cell is elongated spindle-shaped, anteriorly with a neck-like narrowing, which ends in a broadly rounded head-part. The body is slightly widened about its middle part, it is narrowed posteriorly. The size of the cell is 16–20×2–2.5 μ. The swimming-flagella, which are shorter than the body, are situated on both sides of the front part.

Trailing flagella originate from the nonstriated body at the tapering posterior pole. Periplast thin, smooth and hyalin. There are a few glycogen droplets in the finely granulated plasm. Posteriorly there is one contractile vacuole. Its motion is fast, ratating or walking.

It was found in the slightly polluted water of the Hortobágy–Berettyó Canal on December 10, 1971, together with algae, and *Desmarella pyriformis* (SCHILLER) BOURRELLY, *Salpingoeca urceolata* KENT, *Salpingoeca langenella* STOKES, *Lagoena ovata* LEMMERMANN, *Bicoeca oculata* ZACHARIAS, *Bodo compressus* LEMMERMANN. Alpha-mesosaprobic. Its name refers to its thin shape.

It is similar to *Hexamita angusta* (KLEBS) LEMMERMANN, but its shape is elongated, thin and striae and rostrum are missing (LEMMERMANN 1914, STARMACH 1968). Its typical form is shown in Fig. 44.

Hexamita insana spec. nov. (Fig. 46–47)

The cell is heart-shaped, with a depression anteriorly, broadly rounded posteriorly. Its size is 15–18×11–13 μ. Swimming-flagella, somewhat longer than the body,

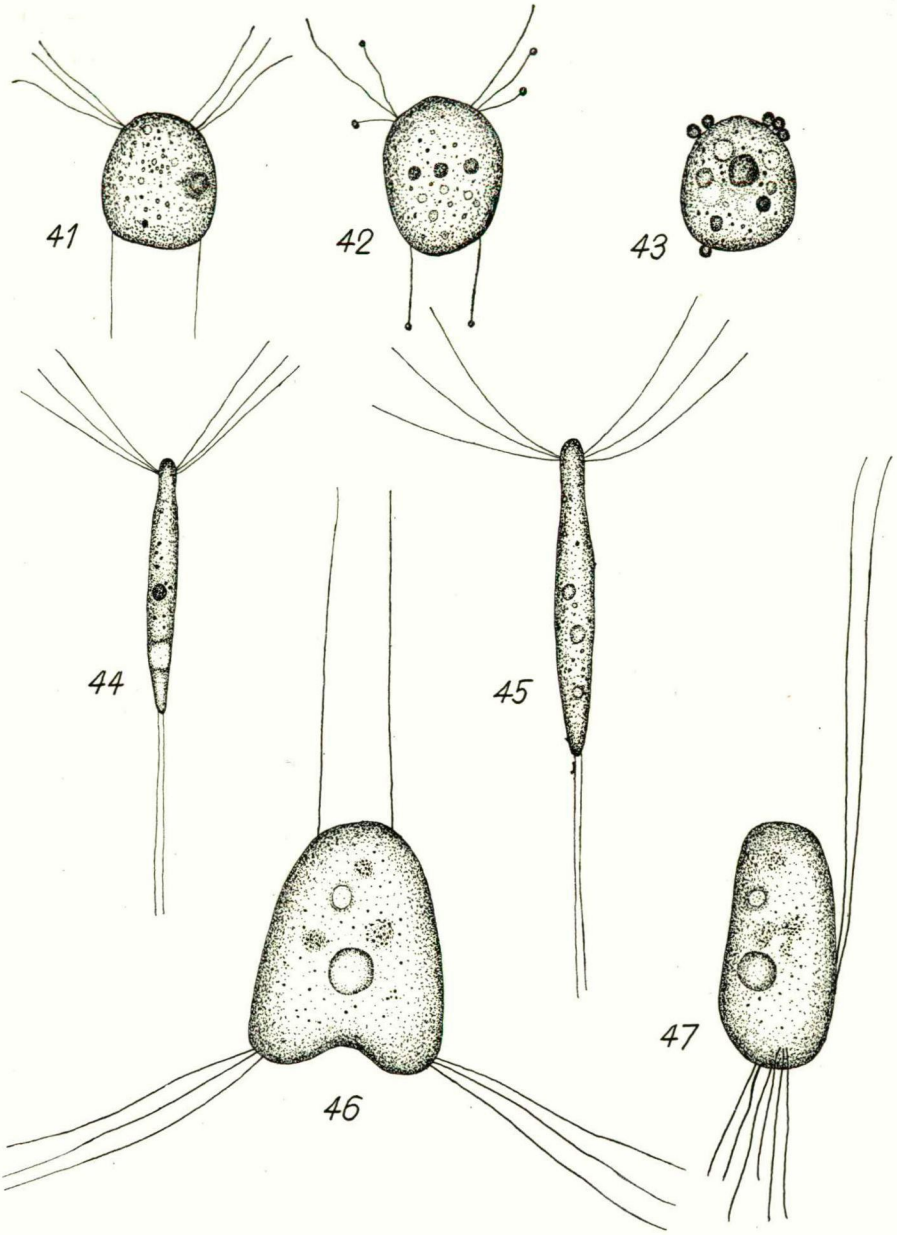

Fig. 41—43. *Hexamita hollandei*, 44—45. *Hexamita gracilima*, 46—47. *Hexamita insana*.

project from the anterior elevations. The trailing flagella project from the upper third of the dorsal side of the body, to a length of 25–32 μ. Periplast thin, smooth and hyalin, but the cell is not metabolic. The protoplasm is spotted by granules. There is a contractile vacuole in the posterior part of the body. Scattered in the plasm, there are several glycogen granules and food vacuoles. The body is splitless. Motion rotating and extremely fast, immoderate, hence its name.

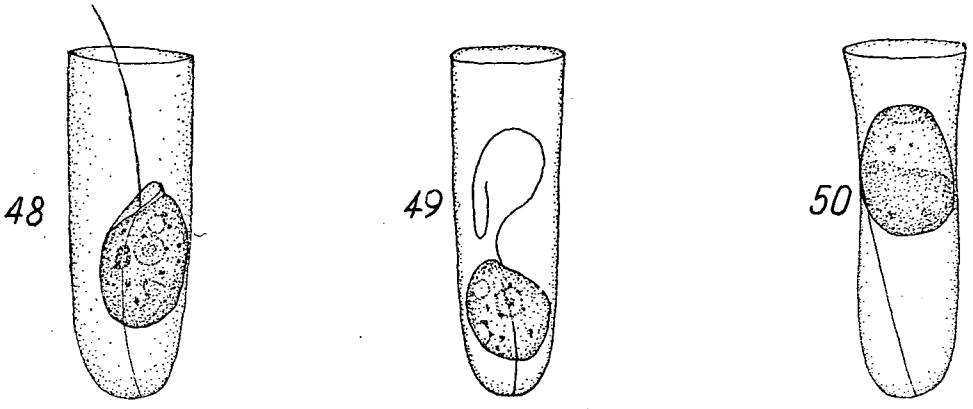

Fig. 48—50. *Bicoeca szabadosi.*

Table VIII — *Some hydrochemical properties in the environment of the new species*

Organisms	Saprobity	Dissolved O_2 mg/l	Consumed O_2 mg/l	BOD_5 mg/l	pH	NH_4+ mg/l	H_2S mg/l
Mastigamoeba polysaprobica	p	0.0	67.0	11.5	7.5	32.0	3.7
Mastigella parva	p	0.0	114.2	153.4	7.0	13.6	2.8
Mastigella maculosa	p	0.0	936.0	434.0	6.7	38.7	–
Mastigella ovata	p	0.0	274.0	128.0	7.0	31.0	9.0
Mastigella compacta	p	9.9	2.9	4.0	7.0	0.2	0.0
Cercobodo lagoenaris	p	0.0	192.0	276.0	7.0	40.0	0.0
Cercobodo robustus	p	0.0	4729.0	706.0	6.0	35.5	0.0
Cercobodo ventricosus	p	0.2	41.6	23.4	7.2	0.9	0.0
Bicoeca starmachi	b	9.4	3.6	4.4	7.2	0.04	–
Bicoeca szabadosi	b—a	11.4	5.2	–	7.7	0.71	–
Hexamita longifila	p	0.0	210.0	345.0	7.5	39.0	1.5
Hexamita skujai	p	0.0	47.0	29.0	7.5	30.0	3.8
Hexamita hollandei	p—a	10.9	16.0	9.6	7.3	25.0	0.0
Hexamita gracilima	a	14.1	17.1	13.8	7.5	1.0	0.0
Hexamita insana	b	13.8	4.5	5.6	7.2	0.2	0.0

It was found in the pure water of the Tápió brook on February 27, 1970, together with diatoms and *Monosiga fusiformis* KENT, *Desmarella irregularis* STOKES, *Bodo globosus* STEIN, *Bodo proximus* SKUJA, *Bodo designis* SKUJA, *Mastigella penardi* LEMMERMANN. Beta-mesosaprobic.

The shape of the new species is very characteristic and can be easily separated from other species (LEMMERMANN 1914, STARMACH 1968).

I wish to express my grateful thanks to K. STARMACH and J. SIEMINSKA for their help. I also wish to thank OSZKÁR ARATÓ and TAMÁS GAÁL for their support.

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Néhány új Zooflagellata faj Magyarországról

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Kivonat

Jelen dolgozat a több éves rendszeres mikroszkópi vizsgálatok során újnak bizonyult Zooflagellata fajokat ismerteti és szemlélteti, megadja környezetük legfontosabb kémiai paramétereit. Az új *Mastigamoeba, Mastigella, Bicoeca, Amastigomonas* és *Hexamita* fajok a legkülönbözőbb vízi biotópokból kerültek elő, folyóktól a szennyvíztisztító berendezésekig.

Nekoliko novih vrsta Zooflagellata iz Madjarske

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Abstract

U radu su na osnovu višegodišnjih sistematskih mikroskopskih ispitivanja prikazane nove vrste Zooflagellata, kao i najvažniji hemijski parametri njihove sredine. *Mastigamoeba, Mastigella, Bicoeca, Amastigomonas* i *Hexamita* kao nove vrste konstatovane su u najrazličitijim vodenim biotopima (reke i baseni sa uredjajima za prečišćavanje otpadnih voda).

Несколько новых разновидностей Zooflagellata из Венгрии

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Резюме

Данная работа сообщает о разновидностях Zooflagellata которые на основании систематических многолетних микроскопических исследований признаны новыми, даётся их описание, приводятся наиболее важные химические параметры их среды. Новые разновидности *Mastigamoeba*, *Mastigella*, *Bicoeca Amastigomonas*, *Hexamita* обнаружены в различных водных биотопах, начиная от рек и до устройств по очищению загрязнённых вод.

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PRELIMINARY INVESTIGATION INTO THE SYRPHIDAE FAUNA OF THE TISZA-VALLEY

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Abstract

The author has collected, among other Diptera, hover flies in the flood plain of the Tisza, since 1959. His present work is the first short summary of the Syrphidae fauna in the Tisza-valley. In the course of elaborating about 2300 specimens, he demonstrated 99 species from this area. From among these, new species are in Hungary: *Triglyphus primus* LOEW, *Neoascia geniculata* MEIGEN, *Paragus haemorrhous* MEIG., *Pyrophaena granditarsa* FÖRSTER, *Eristalis abusivus* COLL., and *Eumerus sogdianus* STACK. From among the rarer species, there are also worth mentioning: *Heringia heringi* ZETT., *Melanostoma dubium* ZETT, *Plecocera latifrons* LOEW.

Introduction

Present work is the first, brief summary of the Syrphidae fauna in the Tisza-valley. Another more detailed monograph, analysing exhaustively the spreading relations of species, the conditions of their occurrence, etc., will be written later when we have more data about the spreading of hover flies in Hungary.

In the framework of the Tisza-research programme, I have collected hover flies in the Tisza-valley since 1959. In the course of my activity, covering the whole Hungarian stretch of the flood-plain of the river, I have collected a round 2300 individuals. As a result of elaborating the material, I have succeeded in demonstrating the occurrence of 99 species. This may have been about one-third of the species, living supposedly in Hungary. This number (taking into consideration the collecting work for almost twenty years) connot be considered as high and it seems probable that later on, it will not rise considerably. Hungary is still only at the beginning of elaborating her hover flies. Thus, it is not possible, to compare the fauna of the Tisza-valley with our other regions. On the basis of analogy of other insect groups it is, however, obvious that in our mountainous districts the Syrphidae fauna is also much richer in species. In the Tisza-valley, the missing of *Cheilosia* species is especially striking and this is probably characteristic of the whole Great Hungarian Plain. At the same time the fauna is, of course, richer in species with larvae developing in water.

In the Tisza-valley, a considerable Diptera material was earlier only collected by ZILAHY-S. In his paper summarizing his results (ZILAHY-S. 1961) the following 13 Syrphidae species may be found: *Neoascia podagrica* FABR., *Melanostoma mellinum* L, *Sphaeroporia menthastri* L., *Sphaeroporia scripta* L., *Episyrphus balteatus* DEG.,

Syrphus vitripennis MEIG., *Volucella zonaria* PODA., *Eristalis arbustorum* L., *Eristalis tenax* L., *Lathyrophthalmus seneus* SCOP., *Eristalis sepulchralis* L. *Helophilus trivittatus* FABR., *Ceroides conopoides* L., From among the species enumerated the occurrence of *Neoascia podagrica* FABR. is uncertain, taking into consideration the difficulties of determining the *Neoascia* species, existing even at present.

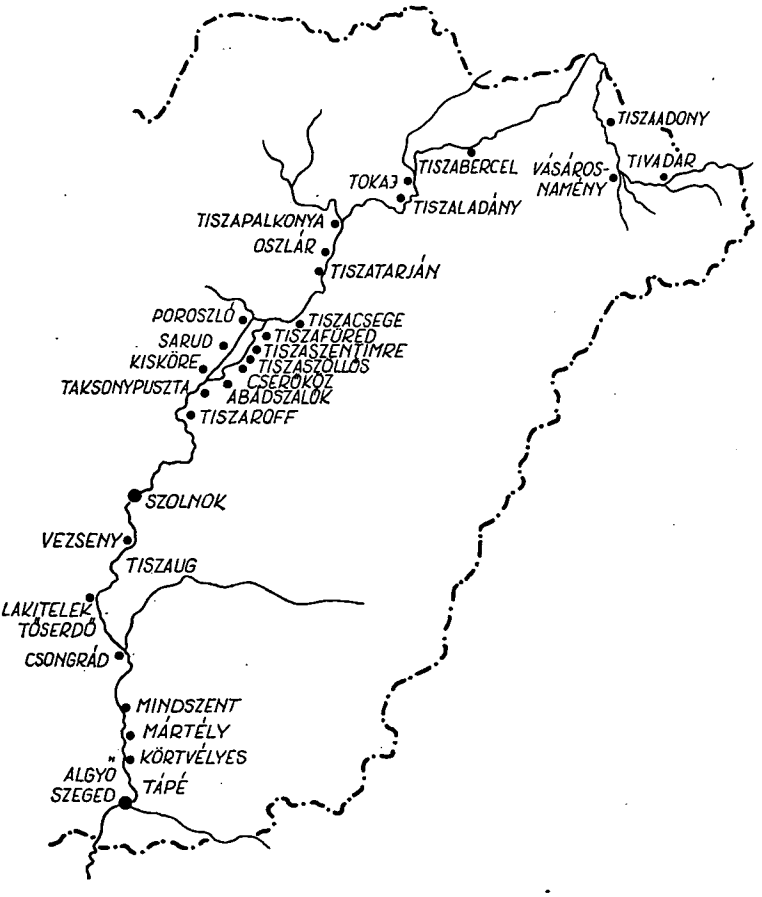

Fig. 1. Syrphidae collecting stations in the Tisza-valley.

Dominance relations

In home relation, we have still only few exact data concerning the occurrence of the various Syrphidae species. It seems, therefore, to be justified to make known some results of the quantitative elaboration of the material collected in the Tisza-valley.

Among the 99 species demonstrated so far, there are 23, the mass participation of which overpasses 1 percent. These come together to 70 percent of the total material. First of these is *Eristalis arbustorum* L. (11.73 percent) wich is probably nationally too one of the most common species. The second place is taken by *Sphaerophoria*

scripta L. (8.73 percent) which can similarly be collected everywhere in large numbers. The third one is *Syritta pipiens* L. (5.69 percent), the fourth one *Melanostoma mellinum* L. (4.52 percent) and the fifth one is *Episyrphus balteatus* DEG. (4.21 percent). These are the nationally common species, although from the latter species I have expected — on the basis of my experiences so far — a higher ratio, of participation.

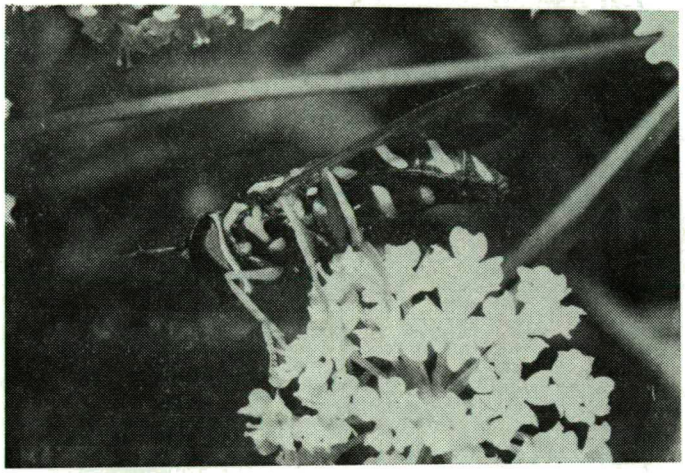

Fig. 2. Detail of flood plain at Kisköre.

Further species, exceeding a participation of 1 percent, are:

Syrphus vitripennis MEIG. (2.91 percent),
Tropidia scita HARR. (2.82 percent),
Helophilus trivittatus FABR. (2.69 percent),
Eristalis tenax L. (2.6 percent),
Pipizella virens FABR. (2.43 percent),
Eristalis aeneus SCOP. (2.26 percent),
Eristalis sepulchralis L. (2.13 percent),
Xanthogramma ornatum MEIG. (2.04 percent),
Sphaeroporia menthastri L. (1.86 percent),
Helophilus pendulus L. (1.73 percent),
Eristalis nemorum L. (1.65 percent),
Myiatropa florea L. (1.6 percent),
Syrphus ribesii L. (1.56 percent),
Parphelophilus versicolor FABR. (1.39 percent),
Metasyrphus corollae FABR. (1.3 percent),
Chrysotoxum festivum L. 1.21 percent),
Liogaster splendida MEIG. (1.13 percent),
Platychirus clypeatus MEIG. (1.13 percent).

The enumerated species are frequent in national relation, as well, with the exception of *Tropidia scita* HARR. The approximately 3 percent participation ratio of this species is strikingly high. It is mentioned by THALHAMMER in the Fauna Regni Hungariae (1899) only from Kalocsa and it does not take part in any hand-written

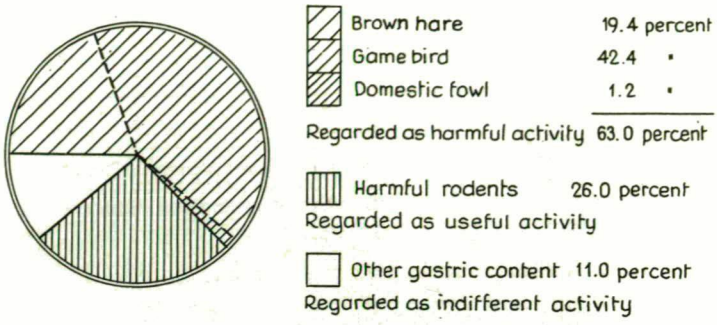

Fig. 3. Chrysotoxum festivum.

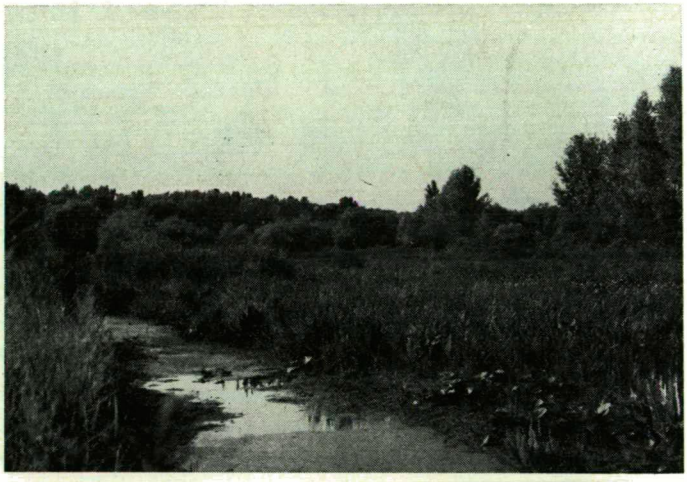

Fig. 4. Lakitelek: Ditail at Tőserdő.

fauna-catalogue (1929). It is worth mentioning that it was found in the Tisza-valley, too, only from Oszlár and the area of the nearby Tiszatarján where the presumable habitat of the larvae of the species is the Tisza Dead-Arm at Oszlár and Tiszatarján. Apart from these, it is only known in this country from Balatonfüred, the shore of Balaton in larger individual numbers.

Rare and for Hungary new species are:

Heringia heringi ZETTERSTEDT 1843.

It is a rare species. For its home occurrence I have only found a single literary datum from Pécs (THALHAMMER 1929).

Triglyphus primus LOEW 1840

It is a sporadically occurring species, generally collected one by one. Its publication from the Tisza-valley is the first literary datum in Hungary.

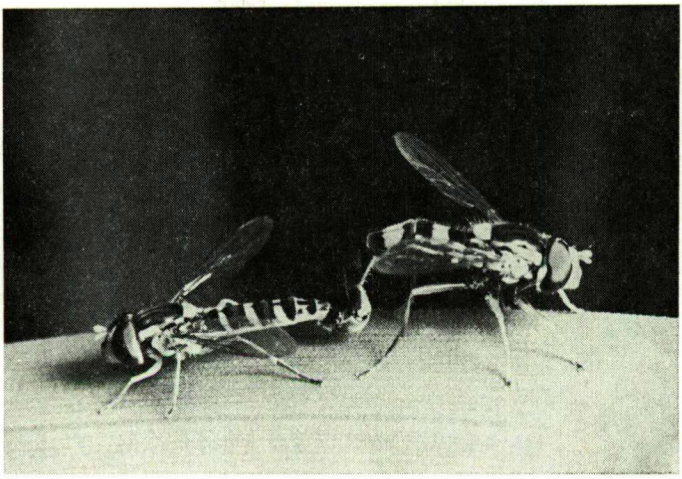

Fig. 5. Sphaerophoria scripta (in copula).

Neoascia geniculata MEIGEN 1822

It is a rare species and a new datum for the home fauna. There was found but a single individual from the Tisza-valley in Oszlár, from the vicinity of the Tisza Dead-Arm.

Paragus haemorrhous MEIGEN 1822

The species is not rare. But in the earlier literature it has a part as a synonym of *Paragus tibialis* FALLEN. It was frequently found in the Tisza-valley. Nonetheless, this is a new datum to the home Syrphidae fauna.

Plecocera latifrons LOEW 1856

There are few literary data concerning its home occurrence. In the Tisza-valley it was found from Tiszafüred.

Melanostoma dubium ZETTERSTEDT 1838

It is a rare species. For its home occurrence I have only found a single datum from Pécs (THALHAMMER 1929). In the Tisza-valley it is rare, as well.

Pyrophaena granditarsa FÖRSTER 1781

It is a rarely found species. I have found no literary datum concerning it. Its demonstration from the Tisza-valley is, therefore, a new datum to the Syrphidae fauna of Hungary.

Eristalis abusivus COLLIN 1931

Externally it is very near to *Eristalis arbustorum* which takes the first place in respect of frequency. It has, therefore, no part in the older publications of literary data. Its demonstration from the Tisza-valley is thus a new datum concerning the

Syrphidae fauna in Hungary. It seems, at any rate, not to be rare in the Tisza-valley (Abádszalók, Cserőköz, Mártély: Körtvélyes-Island, Oszlár, Tiszatarján). In the Tisza-valley, its participation percentage in the collected material is near to 1 percent (0.91 p.c.). Apart from the data of the Tisza-valley, we know concerning its distribu-

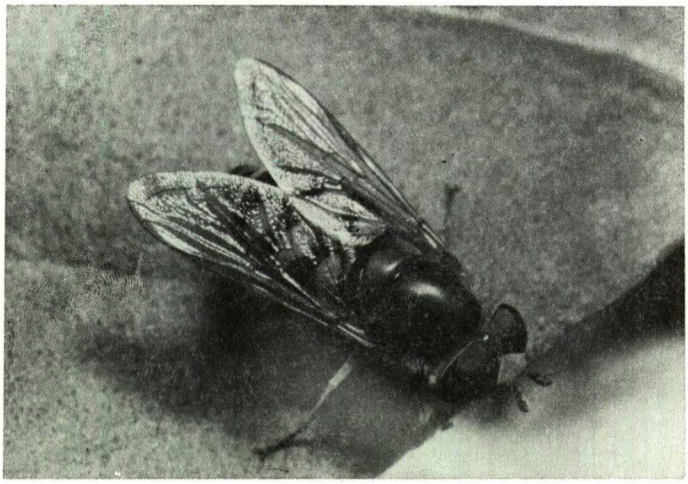

Fig. 6. *Metasyrphus corollae.*

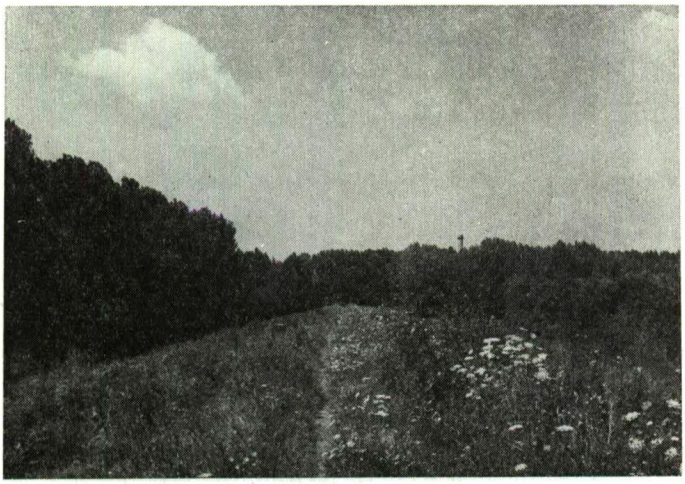

Fig. 7. Detail of the Tisza-dam on the confines of Szolnok.

tion in Hungary for the time being hardly anything. By looking over the Eristalis arbustorum material of the Bakony Museum of Natural Sciences, we have only got but a single female Eristalis abusivum individual. From this, it can be concluded, for the moment, that in a flat region, it may occur considerably more frequently.

Eumerus sogdianus STACKELBERG

Its demonstration from the Tisza-valley is a new datum to the Syrphidae fauna of our country. Its localities are: Cserőköz, Mártély: Körtvélyes-Island, Tiszafüred, Tiszatarján, Tiszaug (leg. Soós, Á), Tokaj. I have collected it, apart from the Tisza-valley, in Szalkszentmárton.

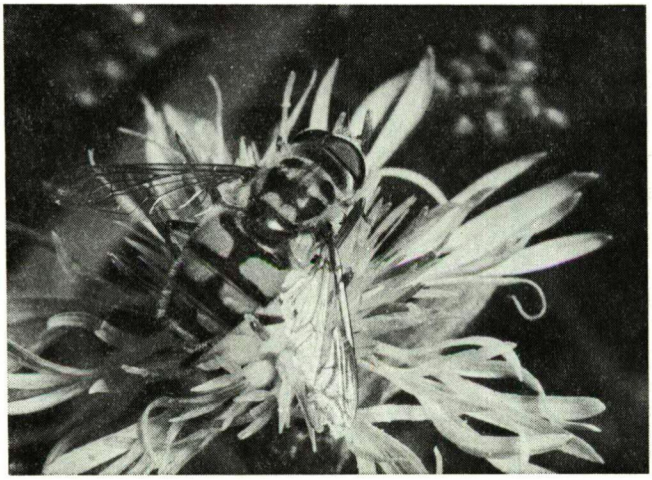

Fig. 8. *Myiatropa florea*

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A Tisza-völgy Syrphidae faunájának előzetes vizsgálata

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Kivonat

A szerző 1959-től gyűjti a Tisza hullámterén — egyéb Dipterák között — a zengőlegyeket. Jelen munkája a Tisza-völgy Syrphidae faunájának első rövid összefoglalása. A mintegy 2300 példány feldolgozása során 99 fajt mutat ki a területről. Közülük Magyarországra új a *Triglyphus primus* LOEW, a *Neoascia geniculata* MEIGEN, a *Paragus haemorrhous* MEIG., a *Pyrophaena granditarsa* FÖRSTER, az *Eristalis abusivus* COLL., és az *Eumerus sogdianus* STACK. A ritkább fajok közül említést érdemel még a *Heringia heringi* ZETT., a *Melanostoma dubium* ZETT., a *Plecocera latifrons* LOEW

Table 1. *Collection data of the Syrphidae species collected from the Tisza-valley*

Serial number	Species	Abádszalók	Algyő	Cserőköz	Csongrád	Kisköre	Lakitelek	Mártély	Mindszent	Oszlár	Poroszló	Sarud	Szeged	Szolnok	Taskonypuszta
1.	*Pipiza fasciata Meig.*														
2.	*Pipiza festiva Meig.*										×				
3.	*Pipiza noctiluca L.*														
4.	*Pipiza quadrimaculata Panz.*														
5.	*Pipizella maculipennis Meig.*	×								×					
6.	*Pipizella virens Fabr.*				×					×			×	×	
7.	*Heringia heringi Zett.*														
8.	*Orthoneura intermedia Lundb.*									×				×	
9.	*Liogaster splendida Meig.*	×								×			×		
10.	*Triglyphus primus Loew.*														
11.	*Cheilosia albipila Meig.*									×					
12.	*Cheilosia carbonaria Egg.*			×											
13.	*Neoascia dispar Meig.*	×								×					
14.	*Neoascia geniculata Meig.*									×					
15.	*Neoascia interrupta Meig.*			×						×					
16.	*Neoascia podagrica Fabr.*												×		
17.	*Paragus bicolor Fabr.*														
18.	*Paragus haemorrhous Meig.*									×				×	
19.	*Paragus quadrifasciatus Meig.*														
20.	*Baccha elongata Fabr.*														×
21.	*Baccha obscuripennis Meig.*												×		×
22.	*Pelecocera latifrons Loew*														
23.	*Melanostoma dubium Zett.*									×					
24.	*Melanostoma mellinum L.*	×		×	×			×		×		×	×	×	×
25.	*Melanostoma scalare Fabr.*	×		×										×	
26.	*Xanthandrus comptus Harr.*			×								×			
27.	*Platychirus albimanus Fabr.*									×					
28.	*Platychirus angustatus Zett.*									×			×		
29.	*Platychirus clypeatus Meig.*	×						×		×					×
30.	*Platychirus fulviventris Macq.*							×		×					
31.	*Platychirus peltatus Meig.*			×						×					×
32.	*Platychirus scutatus Meig.*									×			×		
33.	*Xanthogramma citrofasciatum Deg.*									×					
34.	*Xanthogramma ornatum Meig.*	×								×				×	
35.	*Pyrophaena granditarsa Förster*														
36.	*Pyrophaena rosarum Fabr.*														
37.	*Episyrphus auricollis Meig.*												×		
38.	*Episyrphus balteatus Deg.*	×		×	×	×		×		×			×	×	×
39.	*Chrysotoxum bicinctum L.*														
40.	*Chrysotoxum cautum Harr.*									×					
41.	*Chrysotoxum festivum L.*									×					
42.	*Chrysotoxum intermedium Meig.*														
43.	*Chrysotoxum octomaculatum Curt.*														
44.	*Chrysotoxum vernale Loew*									×					
45.	*Dasysyrphus albostriatus Fall.*				×										
46.	*Dasysyrphus venustus Meig.*									×					
47.	*Scaeva pyrastri L.*	×			×		×								
48.	*Scaeva selenetucus Meig.*									×					
49.	*Metasyrphus corollae Fabr.*	×		×	×			×		×				×	
50.	*Posthosyrphus luniger Meig.*					×				×					
51.	*Syrphus ribesii L.*	×		×		×	×		×	×					

Tápé	Tiszaadony	Tiszabercel	Tiszacsege	Tiszafüred	Tiszaladány	Tiszapalkonya	Tiszaroff	Tiszaszöllős	Tiszatarján	Tiszaug	Tivadar	Tokaj	Tőserdő	Vásárosnamény	Vezseny	Time of collection, broken down to months						
																IV.	V.	VI.	VII.	VIII.	IX.	X.
									×								×					
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Serial number	Species	Abádszalók	Algyő	Cserőköz	Csongrád	Kiskőre	Lakitelek	Mártély	Mindszent	Oszlár	Poroszló	Sarud	Szeged	Szolnok	Taskonypuszta
52.	*Syrphus torvus O.—S.*							×							
53.	*Syrphus vitripennis Meig.*	×		×	×		×		×	×			×	×	×
54.	*Epistrophe bifasciata Fabr.*									×					
55.	*Epistrophe grossularie Meig.*													×	
56.	*Epistrophe nitidicollis Meig.*														
57.	*Melangyna compositarum Verr.*									×					
58.	*Sphaerophoria menthastri L.*	×		×				×		×			×	×	×
59.	*Sphaerophoria rüppeli Wied.*	×		×						×					
60.	*Sphaerophoria scripta L.*	×		×	×	×	×	×	×	×			×	×	×
61.	*Microdon devius L.*									×					
62.	*Microdon mutabilis L.*									×					
63.	*Volucella bombylans L.*														
64.	*Volucella inanis L.*														
65.	*Volucella pellucens L.*														
66.	*Volucella zonaria Poda*												×		
67.	*Eristalis sepulchlaris L.*			×			×	×		×				×	
68.	*Eristalis aeneus Scop.*				×			×	×				×	×	×
69.	*Eristalis abusivus Coll.*	×		×				×		×					
70.	*Eristalis arbustorum L.*	×	×	×	×	×	×	×	×	×	×	×	×	×	
71.	*Eristalis intricaria L.*	×								×					
72.	*Eristalis nemorum L.*			×						×			×		
73.	*Eristalis pertinax Scop.*			×						×					
74.	*Eristalis pratorum Meig.*									×					
75.	*Eristalis tenax L.*	×	×	×	×	×	×	×	×	×	×	×	×	×	×
76.	*Myiatropa florea L.*						×		×	×			×	×	
77.	*Helophilus pendulus L.*			×						×			×	×	
78.	*Helophilus trivittatus Fabr.*	×			×		×	×		×	×		×	×	×
79.	*Lampetia flava Sack.*									×					
80.	*Lampetia spinipes Fabr.*														
81.	*Cerioides conopoides L.*												×		
82.	*Parhelophilus futetorum Fabr.*									×					
83.	*Parhelophilus versicolor Fabr.*									×					
84.	*Eurinomyia lineata Fabr.*									×					
85.	*Eurinomyia lunulata Meig.*									×					
86.	*Eurinomyia transfuga L.*									×					
87.	*Liops vittata Meig.*			×											
88.	*Mesembrius peregrinus Loew*							×		×				×	
89.	*Eumerus sogdianus Stack.*			×				×							
90.	*Eumerus strigatus Fabr.*	×		×				×		×					
91.	*Eumerus tricolor Fabr.*									×					
92.	*Eumerus tuberculatus Rond.*														
93.	*Ferdinandea cuprea Scop.*									×					
94.	*Tropidia scita Harr.*									×					
95.	*Syritta pipiens L.*	×		×				×	×	×			×	×	×
96.	*Xylota nemorum*														
97.	*Xylota segnis L.*														
98.	*Xylota sylvarum L.*									×					
99.	*Xylota tarda Meig.*														

	Time of collection, broken down to months						
	IV.	V.	VI.	VII.	VIII.	IX.	X.
Tápé	×	×	×	×	×	×	×
Tiszaadony	×						
Tiszabercel	×	×	×	×	×	×	
Tiszacsege	×	×	×	×	×	×	×
Tiszafüred	×	×	×	×	×	×	×
Tiszaladány	×	×	×	×	×	×	
Tiszapalkonya	×	×	×	×	×	×	×
Tiszaroff	×	×	×	×	×	×	×
Tiszaszöllős	×	×	×	×	×	×	×
Tiszatarján	×	×	×	×	×	×	×
Tiszaug	×	×	×	×	×	×	×
Tivadar	×	×	×	×	×	×	×
Tokaj	×	×	×	×	×	×	×
Tőserdő	×	×	×	×	×	×	×
Vásárosnamény	×	×	×	×	×	×	×
Vezseny	×	×	×	×	×	×	×

Prethodna ispitivanja faune Syrphidae doline Tise

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Abstract

Autor, pored drugih Diptera, na plavnom području reke Tise od 1959. god. prikuplja i Syrphidae. Ovaj rad predstavlja prvi kratak rezime faune Syrphidae doline Tise. Od 2300 obradjenih primeraka utvrdjeno je prisustvo 99 vrsta na ovom području. Za faunu Madjarske su nove vrste: *Triglyphus primus* LOEW, *Neoascia geniculata* MEIGEN, *Paragus haemorrhous* MEIG., *Pyrophaena granditarsa* FÖRSTER, *Eristalis abusivus* COLL. i *Eumerus sogdianus* STACK. Od redjih vrsta zaslužuju pažnju još: Heringia heringi ZETT., Melanostoma dubiumZETT., Plecocera latifrons LOEW.

Предварительное исследование фауны Syrphidae в долоие Тисы

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Рэзюме

Начиная с 1959 года, павтор собирает в ойме Тисы жужжащих мух (вместе с другими Diptera). Настоящая работа — первое краткое резюме относительно фауны Syrphidae в долине Тисы. Из числа 2300 собранных экземпляров автор выделяет на этой территории 99 разновидностей Из них новыми для Венгрии являются *Triglyphus primus* LOEW, *Neoascia geniculata* MEIGEN, *Paragus haemorrhous* MEIG,, *Pyrophaena granditarsa* FÖRSTER, *Eristalis abusivus* GOLL,, *Eumerus sogdianus* STACK.
Из числа более редких видов следует отметить *Heringia heringi* ZETT,, *Melanostoma dubium* ZETT., *Plecocera latifrons* LOEW.

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REGENERATION OF THE APOIDEA INSECT FAUNA IN THE FLOOD AREA, AS A FUNCTION OF THE ECOLOGICAL CONDITIONS

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Abstract

In flood areas, the Apoidea insect regeneration is a function of the durability resp. date of flood-waves. The vegetation regenerates one and a half, two months after the flood-waves have passed. After summer floods there cannot develop any connected plant associations more. The structure of the Apoidea insect population is determined first of all by their connection with nutritive plants. The factors determining the regeneration, resp. structure of the Apoidea population in the area investigated are the climatic conditions, the vegetation poor in species combinations, culture effects, and the distance from protecting dams.

Introduction

The area investigated is Körtvélyes Island. The Mártély–Körtvélyes stretch of the Tisza-valley was declared a Region Conservation District by the National Nature Conservance Office in 1971. The region has relatively still preserved its traits from before the river control of the Tisza. Körtvélyes Island is not exposed to anthropogenous effects. In the region, hymenopterological investigations were performed earlier by G. ZILAHI–SEBESS, and of late years by L. MÓCZÁR, GY. GYÖRFFY, L. GALLÉ, and L. TANÁCS (1975).

Method

After the flood-waves had passed, carried out time collections for one hour in each of the two divided zones of the island, parallel with the regeneration of the vegetation, between 10–15 o'clock. Together with the collections on the island, I have also performed investigations on the dam, as well, in order to establish, resp. compare the structures of the Apoidea insect population. On Körtvélyes Island, collections took place in 3 to 4 weaks periodes. The Apoidea insects were collected with a butterfly net. On the days of investigations, the meteorological data were recorded. In the course of observations, the connections of some Apoidea species with their nutritive plants, as well as the effect of environmental factors on the regeneration and the change in the structural composition of the Apoidea population were followed with attention.

Area of the investigation

Körtvélyes Island lies on a territory of about 800 hectares closed by the living Tisza and a dead-arm (between river-km 201–204). Its ground consists mostly of inundation soils, without structure and deficient in calcium. The material of the ridges

Table 1. *Meteorological data of the investigated days*

	1975			1976				1977				
	IX. 4.	IX. 17.	IX. 18.	VII. 1.	VIII. 7.	VIII. 29.	IX. 20.	VI. 25.	VII. 13.	VII. 27.	VIII. 23.	X. 1.
Temperature	26.2	28.7	25.9	28.9	23.0	26.8	17.6	26.8	26.6	20.1	22.7	25.6
Humidity	53	59	46	31	39	35	87	38	36	85	55	41
Air pressure	1002	1017	1019	1008	1009	1012	1009	1006	1007	1004	995	1008
Clouding	–	–	–	30±5	15±5	20±5	–	25±5	–	75±10	30±8	30±5
Force of wind	1.22	3.78	3.75	1.94	3.33	3.42	3.53	6.11	2.22	3.60	4.25	4.67

Note: Temperature is given in °C, humidity and clouding in percentage, air pressure in mbar, force of wind in m/sec.

of higher relief, extending along the river-bed, is sand. At the eastern and western fringes of the island, soft-woods of half-cultured character, willow-poplar groves (*Salicetum albae-fragilis* ISSLER, 26) ribbonlike follow the riverside-line of the living Tisza and the dead-arms. At their shrub stratum *Rubus caesius* facies is the widest-spread shrub. At the side-line of the river-bed the zone of a shrub-willowy (*Salicetum*

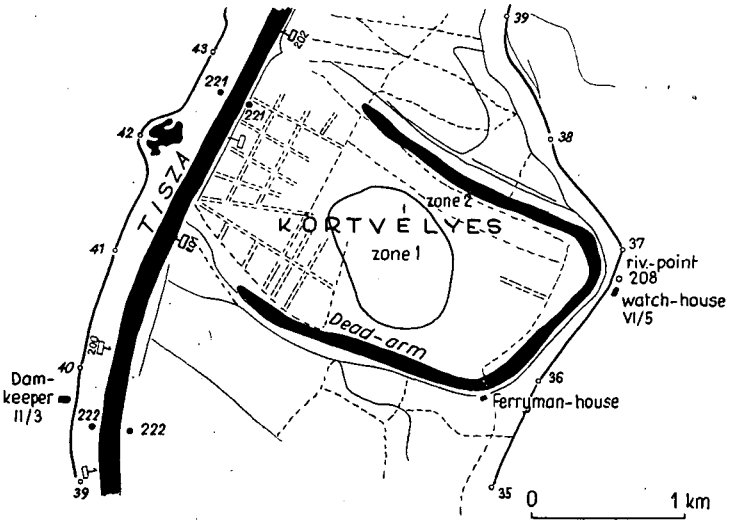

Fig. 1. Area investigated.

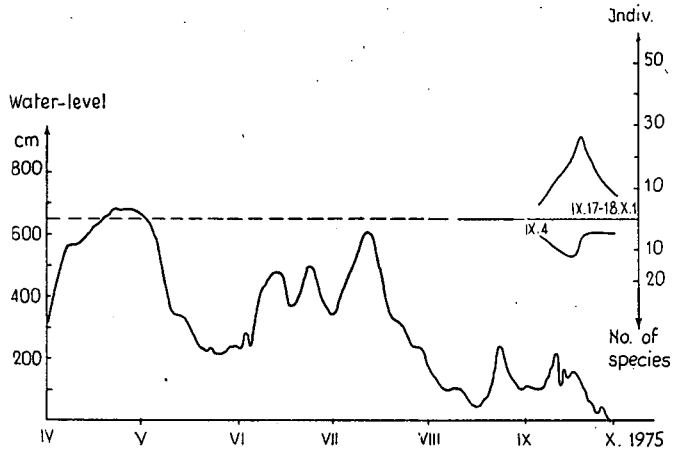

Fig. 2. Regeneration of the Apoidea insect fauna after passing of the flood-wave in 1975.

triandrae MALCUIT, 29) forms a contiguous belt. At the eastern and western fringes of the island Canadian poplar plantations lie. In the central part of the island, the Large-meadow, the plant-coenoses of marshland meadow foxtails (*Lythro-Alopecuretum pratensis* [NOWINSKI, 28] BODROGK. J. J. developed. *Chrysanthemum serotinum*

L., *Lythrum salicaria* L., *L. virgatum* L., *Symphytum officinale* L., *Euphorbia lucida* W & K and *Vicia cracca* L. mean an important pollen- and nectar-source for Apoidea. The species combination is poor because but a few species can endure the 3 to 4 m water-height for weeks and silting up connected with that. In the meanders of filledup beds two associations are wide-spread: those of reed-grass (*Carici-Typhoidetum*

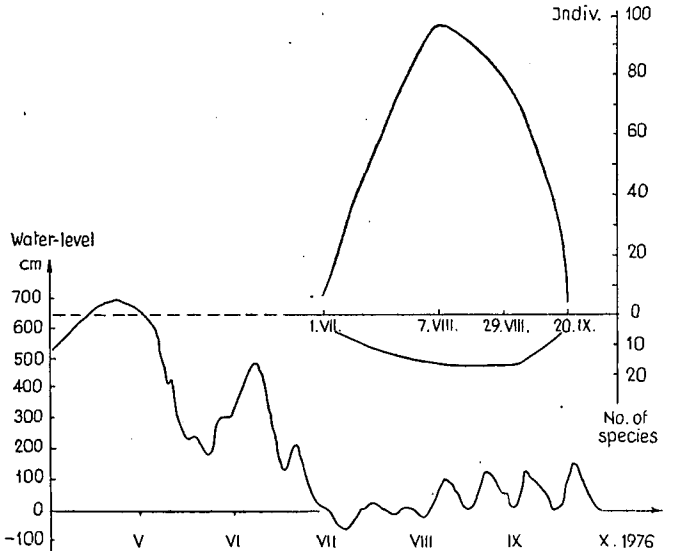

Fig. 3. Regeneration of the Apoidea insect fauna after passing of the flood-wave in 1976.

arundinaceae Soó 71) and sweet-grass (*Glycerietum maximael* NOWINSKI, 28, HUECK, 31). After filling up, stands of sharp- and bowing-sedges (*Caricetum gracilis* GRABNER & HUECK, 31, 37) will gain ground. Their extension in the years with floods is larger. In the northern part of the island, on higher reliefs, cultures of short growing season developed in the zone of sandy soil, like maize for silage and sunflower. Here can also orchards be found sporadically. Independently of hoed plants, the following sub-associations developed (ANDÓ–BODROGKÖZY–MARIÁN 1974):

(a) Hungarian grass/millet association (*Rorippo-Setarietum,* ÚJVÁROSI 54, Soó 61), in sour alluvial soils,

(b) amaranth association (*Amarantho-Chenopodietum albi,* Soó 47),

(c) in hard or loose sand soil, digitated grass — purslane association (*Digitario-Portulacetum* BODROGK. 55).

After the flood-waves enduring for a longer time passing from Spring through the Summar, the plant associations cannot take shape, resp. they run into one another. The map of the investigated area is contained in Fig. 1.

Climatic conditiom

In summer season, on the flood-plain clearings, temperature is often higher than in the adjacent areas of the Great Plain (ANDÓ–BODROGKÖZY–MARIÁN 1974). In summer season, the flood-plain woods and their immediate environment have a

lower temperature than the adjacent areas of the Great Plain. The surface of the water of large mass has an extreme modifying effect on climate. The annual cloud formation is here the smallest in the country. The degree of average cloudiness of the month August is lower than 35 percent (ANDÓ 1958, 1969). The meteorological data of the observed days are recorded in Table 1.

Discussion of results

The Apoidea insect generation is influenced by the lastingness and dates of flood-waves. Passing of the flood-wave culminating in late April or early May results the regeneration of the vegetation, one and half — two months after time. In late June, early July — on the basis of some observations at Körtvélyes — there develop contiguous plant associations. On the other hand, if the flood-wave is lasting, resp. if culmination takes place in the middle of Summar, the vegetation can regenerate only partially, there cannot develop any plant associations. According to the data observed on Körtvélyes Island, the island gets under water at a 650 cm height of water. A water-level over 6 metres results in covering 40 to 50 percent of the island with water. This happened in 1975 (Fig. 2). Species combination is poor, mainly the flower-covering of *Lythrum salicaria* L. and L. *Virgatum* L. is important. Consequently, the species number of the Apoidea population is low. In 1975, the individual number of *Melitta nigricans* ALFKEN, *M. tricincta* K., as well as that of *Tetralonia salicariae* LEP., vising the plant *Lythrum salicaria* and *L. virgatum* L., was considerable (Table 2). The first note is marking the individual number, the figure in brackets the zone in Table 2. It is noted with figure 3 if the Apoidea species occurs in both zones. The individual number of honey-bees is not contained in the density data of Figs. 2, 3, and 4 because in the vicinity of the dam-keeper houses the workers, swarming out of the nearby hives, placed on the dams, would make irreal the density values. In 1976, resp. 1977, the passing of the spring flood-wave at the end of May, resp. at the beginning of June, resulted in the formation of plant associations. By the adjoining vegetation the widening of the structure of population, resp. an increase in density is engendered (Table 2). Particularly the number of *Halictus* and *Lasioglossum* species increased. The most important population-producers are the individuals of *Melitta nigricans* ALFKEN — in a probable evolutionary connection with the flower of Lythrum salicaria L. — as well as those of *Melitta tricincta* K. and *Tetralonia salicariae* LEP. The weed associations of the cultivated plants, sown in the northern part of the island, were visited by the considerable number of the individuals of *Andrena flavipes* PZ., *Bombus terrestris* L. and *Lasioglossum malachurum* K. species.

In the course of the regeneration of the vegetation, the first visitors of flowers were the *Bombus* species of long flying radius and pollilectic nourishment, like *B. terrestris* L., *B. silvarum distinctus* VOGT., as well as *Anthophora furcata* PZ. and *Apis mellifica* L. (Table 2). In early Autumn, the bulk of population was composed by the *Bombus,* the *Halictus* and *Lasioglossum* species.

In the middle of the Large-Meadow zone 1 takes place. Its vegetation is poor. Correspondingly, the flowers of the species *Lythrum,* as well as those of *Vicia cracca* L., forming here and there bushes, and of *Symphytum officinale* L., are visited but by few species. The Apoidea population of zone 1 is mainly formed by *Melitta nigricans* ALFKEN, *M. tricincta* K., a few *Halictus,* resp. *Lasioglossum,* as well as the continuously reproductive eusocial *Bombus* species, the latter ones being of large energy flow. The vegetation of zone 2 is, because of the weed associations, more varied.

Table 2. *Structure of the flower-visiting Apoidea population in Kőrtvélyes Island*

Species	1975			1976				1977				
	IX. 4.	IX. 17.	IX. 18.	VII. 1.	VIII. 7.	VIII. 29.	IX. 20.	VI. 25.	VII. 13.	VII. 27.	VIII. 23.	X. 1.
Prosopis cornuta SM.									1(2)			
P. annularis K.									1(2)			
P. angustata SCHCK.						3(2)						
P. gracilicornis MOR.						1(2)						
P. brevicornis NYL.						1(2)						
P. gibba SAUND,											1(2)	
P. euryscapa FÖRST.											1(2)	
Melitta nigricans ALFKEN.			13(1)		26(3)	15(3)			6(1)	3(1)	23(3)	
M. tricincte K.		3(1)	4(1)			32(3)				1(2)	1(1)	
Macropis labiata F.									3(1)	1(2)		
Dasypoda plumipes PZ.											1(2)	
Andrena cordialis MOR.									1(1)			
A tibialis K.											(12)	
A. flavipes PZ.					23(2)					1(2)	5(3)	
A. ovatula K.									1(2)	1(2)		
Nomada fucata PZ.									1(1)	1(2)		
N. flavopicta K.						1(2)			1(2)	1(2)		
Halictus 4-cinctus F.		2(2)				1(2)			1(2)			
H. simplex BLÜTHG.		1(2)			3(3)							3(3)
H. veneticus EBMER					2(2)	1(2)					2(2)	
H. maculatus SM.												4(2)
H. eurygnathus BLÜTHG.		1(1)										
H. subauratus (ROSSI)						4(3)					(22)	1(2)
H. geminatus PÉREZ												1(2)
H. perkinsi BLÜTHG.												1(2)
H. kessleri BRAMS.												2(2)
Lasioglossum leucozonium (SCHRK.)		1(2)			1(2)							2(3)
L. morbillosum (KRIECHB.)		2(2)			1(1)							
L. zonulum (SM.)												1(2)
L. 4-notatulum (SCHCK.)												7(2)
L. punctatissimum SCHCK.)												1(2)
L. puncticolle (MOR.)												1(2)

L. nitidiusculum (K.)												1(2)
L. malachurum (K.)		2(2)			10(3)							8(3)
L. calceatum (SCOP.)					1(2)							
L. albipes (F.)					1(2)							
L. villosulum (K.)	1(2)											
L. nigripes (LEP.)		1(2)										
Megachile pilidens ALFKEN										1(2)		
M. centuncularis L.											3(2)	
M. willoughbiella K.											1(2)	
M. rubrimana MOR.						1(2)						
Eriades truncorum L.						2(1)			2(2)	2(2)	2(2)	
Anthidium strigatum PZ.										1(2)		
A. florentinum F.									1(2)		1(1)	
A. tenellum MOCS.					2(2)							
A. lituratum PZ.						2(2)						
Coelioxys acuminata NYL.										1(2)		
C. elongata LEP.						1(2)						
Tetralonia nana MOR.		2(2)										
T. ruficornis F.					2(2)				4(1)	2(2)	3(3)	
T. salicariae LEP.		4(1)			20(3)	11(3)			1(1)	7(3)	3(1)	
Anthophora furcata PZ.						1(1)						
Bombus terrestris L.	1(1)		3(2)	5(3)	2(2)		1(2)	2(2)	4(3)	4(3)	1(2)	
B. agrorum F.										1(2)		
B. derhamellus K.					1(2)	2(2)						
B. silvarum distinctus VOGT.	1(1)	1(2)	6(3)	2(2)	1(1)		2(2)	3(3)	2(1)	4(3)	1(2)	
Apis mellifica L.	1(2)	5(3)	7(3)	3(2)	7(3)	5(3)	1(2)	4(3)	2(1)	3(2)	1(2)	

This results in the widening of population structure. The flowers of *Inula britannica* L. are visited by various Prosopis species but there occur also individuals of Anthidium and *Megachile* species. There were collected from this area two parasitical species: *Coelioxys elongata* LEP. and *C. acuminata* NYL. In the course of examinations, I have not found any Apoidea nest. It is not probable that the populations of nests could go through the difficulties of the 2 to 4 m high water coverage enduring even 2 to 3 months long in annual relation. It is, on the other hand, to be imagined that some species make their nests over the level heights of floods, in the tree-trunks of the flood-plain.

The Apoidea population of the dams fringing the island is considerably richer in species. A comparison of the structure of the Apoidea population is given by Table 3. Several flower-visiting species do not visit the areas of the flood-plain for lack of nutritive plants and as a result of distance. From the structure of population, the considerable visitors of the spring and early summar aspect, like the *Eucera* and *Osmia* species are completely missing the island.

In the flower-visiting and pollination of the orchards (first of all apple, as wel as pear), lying on the higher levels of the flood-plain, apart from the honey-bees the part taken by the *Halictus* species is considerable.

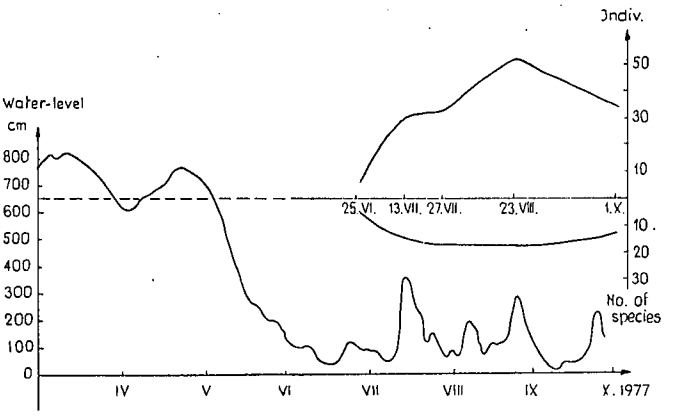

Fig. 4. Regeneration of the Apoidea insect fauna after passing of the flood-wave in 1977.

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Table 3. *Comparison of the structure of the flower-visiting Apoidea population on Körtvélyes Island and the accompanying dams between river-km 201–204*

Species	Dam on the right		Körtvéleyes Island, zone 1		Körtvélyes Island, zone 2		Dam on the left	
	♀	♂	♀	♂	♀	♂	♀	♂
	1.	2.	3.	4.	5.	6.	7.	8.
Prosopis cornuta SM.					+		+	
P. annularis K.					+			
P. angustata SCHCK.					+	+		
P. gracilicornis MOR.						+		
P. brevicornis NYL.					+			
P. gibba SAUND.						+		
P. euryscapa FÖRST.						+	+	+
Melitta tricincta K.			+	+	+		+	
M. nigricans Alfken		+	+	+	+	+		
M. leporina PZ.								+
Macropis labiata F.				+		+		
Dasypoda plumipes PZ.					+		+	
Systropha curvicornis SCOP.		+					+	
Andrena flavipes PZ.			+	+	+	+	+	+
A. labialis K.							+	+
A. ovatula K.					+	+	+	
A. cordialis MOR.				+				
A. dorsata K.							+	
A. tibialis K.					+			
A. toraxaci GIR.								+
Nomada fucata PZ.				+		+		+
N. flavopicta K.					+	+		
N. distinquenda MOR.								+
Camptopoeum friesei MOCS.								+
C. frontale F.								+
Ammobates vinctus GERST.							+	
Halictus 4-cinctus (F.)					+	+	+	+
H. 6-cinctus F.							+	+
H. fulvipes KLUG.							+	+
H. maculatus SM.					+	+	+	
H. eurygnathus BLÜTHG.				+			+	
H. simplex BLÜTHG.	+	+	+	+	+	+	+	+
H. veneticus EBMER					+	+	+	+
H. scabiosae (ROSSI)								+
H. sajói BLÜTHG.								+
H. subauratus (ROSSI)	+		+		+	+	+	
H. kessleri BRAMS.	+				+		+	
H. geminatus PÉREZ					+			
H. perkinsi BLÜTHG.					+			
Lasioglossum morbillosum (KRIECHB.)					+		+	+
L. leucozonium (SCHRK.)			+		+		+	+
L. zonulum (SM.)						+	+	+
L. villosulum (K.)					+			+
L. 4-notatulum (SCHCK.)					+	+		
L. puncticolle (MOR.)						+		
L. calceatum (SCOP.)					+			
L. nigripes (LEP.)						+	+	+
L. nitidiusculum (K.)						+		
L. malachurum (K.)	+	+	+	+	+	+	+	+
L. albipes (F.)					+			
L. marginatum (BR.)							+	+
L. politum (SCHCK.)							+	+

L. pauxillum (SCHCK.)								+
L. trichopygum (BLÜTHG.)	+						+	+
L. lucidulum (SCHCK.)	+						+	
L. lineare (SCHCK.)								+
L. laticeps (SCHCK.)							+	
L. glabriusculum (MOR.)							+	
L. intermedium (SCHCK.)							+	
L. punctatissimum (SCHCK.)						+		
Sphecodes gibbus L.								+
S. monilicornis L.							+	+
Megachile pilidens ALFKEN						+	+	
M. centuncularis L.		+			+		+	+
M. willoughbiella K.						+	+	+
M. rubrimana MOR.					+			
M. argentata F.	+						+	+
M. ericetorum LEP.							+	+
M. rotundata F.							+	
M. leucomalla GERST.							+	
Osmia atrocoerulea SCHILL.							+	
O. aurulenta PZ.							+	
O. spinulosa K.							+	
O. tridentata DUF. & PERR.							+	
O. melanogastra SPIN.							+	
Eriades truncorum L.	+		+	+	+	+	+	
E. appendiculatus MOR.							+	
Anthidium tenellum MOCS.					+			
A. lituratum PZ.					+	+		+
A. oblongatum LATR.							+	
A. strigatum PZ.						+		
A. florentinum F.			+		+			
Coelioxys acuminata NYL.					+		+	
C. elongata LEP.		+			+			
C. rufocaudata SM.								+
Tetralonia armeniaca MOR.							+	+
T. macroglossa ILL.							+	
T. salicariae LEP.			+	+	+	+	+	+
T. nana MOR.					+		+	+
T. ruficornis F.			+	+	+	+	+	
Eucera pollinosa SMITH							+	
E.. tuberculata F.							+	+
E. seminuda BR.							+	+
E. interrupta BAER.							+	+
E. nitidiventris MOCS.							+	+
E clypeata EV.							+	+
Anthophora furcata PZ.			+				+	
Epeolus tristis SMITH							+	+
Xylocopa violacea L.							+	
Ceratina cyanea K.	+						+	+
Bombus argillaceus SCOP.								+
B. derhamellus K.	+					+	+	+
B. helferanus Seidl.							+	
B. hortorum L.							+	
B. agrorum F.						+	+	+
B. terrestris L.	+		+	+	+	+	+	+
B. silvarum distinctus Vogt.	+	+	+	+	+	+	+	+
B. lapidarius L.							+	+
B. muscorum F.							+	+
Psithyrus rupestris F.		+						+
P. vestalis Geoffr. & Fourcr.								+
Apis mellifica L.	+		+		+	+	+	+

Note: The Table contains also the 56 Apoidea species, collected in 1974, on the left-sid dam, in the stretch between river-km 201 to 204 (Tanács, 1975).

Méhalakú rovarregeneráció hullámtéren az ökológiai viszonyok függvényében

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Kivonat:

Hullámtereken a méhalkatú rovarregeneráció az árhullámok tartósságának, illetve időpontjának a függvénye. A vegetáció az árhullám levonulása után másfél, két hónapos késéssel regenerálódik Nyári áradások után már nem tudnak kialakulni összefüggő növénytársulások. A méhalkatú rovarnépesség szerkezetét elsősorban tápnövénykapcsolatok határozzák meg. A populáció zöme nedvességkedvelő, illetve közönbös ökológiai elterjedési típusú faj. A vizsgálati területen a klimatikus viszonyok, a vegetáció fajkombinációjának a szegénysége, kultúrhatások, a védőtöltésektől való távolság a méhalkatú népesség regenerációját, illetve szerkezetét meghatározó faktorok.

Regeneracija Apidae na plavnom području u funkciji ekoloških faktora

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Abstract

Na plavnim područjima regeneracija Apidae zavisi od vremena i du⁹ine trajanja plavljenja Za regeneraciju vegetacije nakon povlačenja vode potrebno je 1,5 do dva meseca. Posle letnjih plavljenja se ne javljaju kompletne biljne zajednice. Struktura populacija Apidae u pryom redu je odredjen biljkama hraniteljkama. Gro populacija čine vrste prilagodjene uslovima veće vla⁹nosti ili su vrste prosečnih ekoloških zahteva. Na ispitivanom području regeneracija i struktura populacija Apidae zavisi od klimatskih uslova, siromaštva vegetacije u vrstama, antropogenog uticaja i udaljenosti od odbrandbenih nasipa.

Регенерация насекомых пчёлообразного типа в пойме в зависимости от экологических условий

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Резюме

Регенерация насекомых пчёлообразного типа в поймах зависит от продолжительности и времени наступления паводков. Вегетация регенерируется через полтора-два месяца после оттока паводковых вод. Псоле летних паводков уже не успевают сформироваться взаимозависимые растительные сообщества. Структура насекомых пчёлообразного типа определяется в первую очередь их связью с питающими растениями. Большая часть популяций относится к влаголюбивому типу или типу, нетребовательному к экологическим условиям. На исследуемой территории факторами, определяющими регенерацию или структуру пчёлообразных насекомых, являются климатические условия, бедность видовых комбинаций вегетации, влияние культуры, расстояние от защитых дамб.

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PROTECTED AREAS OF THE FLOOD PLAIN OF THE LOWER-TISZA REGION, THEIR APOIDEA INSECT POPULATION AND THE CONNECTIONS OF THESE WITH NUTRITIVE PLANTS

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Abstract

The author collected 111 Apoidea species from the area investigated. In the flood plains, the richness of the Apoidea insect populations can be attributed to the connections with nitritive plants. The species combination of the vegetation depends upon the height of the level of plain, the duration and date of flood-waves.

Introduction

The ancient character of the Tisza-valley has strongly been changed by the river control. The anthropogenous effects, the drainage of marshes resulted in the expausion of the areas to be used for agrarian purposes. The Mártély–Körtvélyes stretch of the Tisza-valley was declared a Region Conservation District by the National Nature Conservation Office, in 1971. The single units of the District serve for different aims. Körtvélyes Island is not exposed to any anthropogenous effect, it serves first of all instructional and nature-conservancy purposes. The other investigated area was Tőserdő, a large part of which is a flood-plain forest and forms one of the units

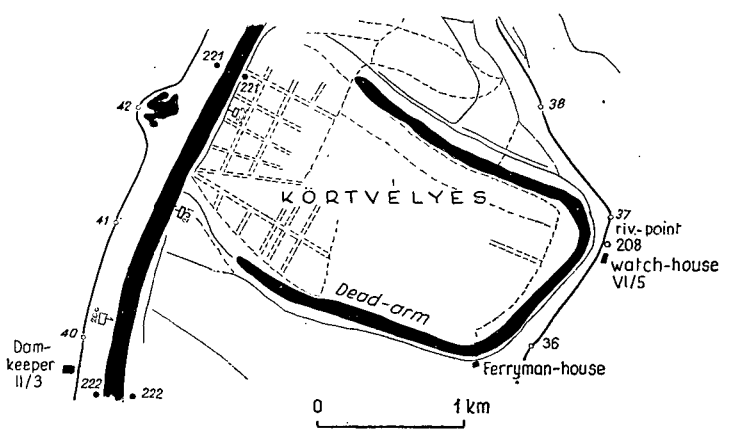

Fig. 1. Investigated area on Körtvélyes Island.

of the Kiskunság National Park as a nature conservation area. The Alpár meadow is connected with the southern part of the forest. The Alpár meadow is, in respect of its character, a wet, stagnant grassland of the flood-plain. All the three areas are exposed to periodical floods of the river Tisza although the western part of Tőserdő, lying on a higher level, is free from the flood-waves. Here shows the level even 7 to 8 m differences and in the clearings of the forest, along the ways, on the tops of sand-hills, the plants of xerophilous character appear. It was an aim of investigation, to compare the Apoidea population of these three areas, taken as a function of the connections with the nutritive plants and to analyze the composition of the Apoidea fauna, with full knowledge of the environmental factors.

Materials and Methods

I have performed 1-hour time collections in all the three investigated areas, in an annual cross-section, during the flying time of the Apoidea. Körtvélyes-Island made an exception. Here I divided the island in two zones and applied 2×1 hour time collections. Density observations were not carried out in either of the areas, the grund being unsuitable for this. The collections took place between 10–15 o'clock. In the course of observations, I have recorded the connections of Apoidea with the nutritive plants. Hymenoptera were collected with butterfly nets but only the Apoidea were elaborated.

Plant associations of the sites of collection

The plant associations of the investigated areas are known on the basis of the works of GY. BODROGKÖZY.

I. Plant associations of the Large Meadow in Körtvélyes-Island:
   1. *Alopecuretum pratensis*
   2. *Garici-Typhoidetum arundinaceae*
   3. *Glycerietum maximae*

In the northern part of the island, appart from the hoed plants, there have developed still three sub-associations (ANDÓ–BODROGKÖZY–MARIÁN 1974).

II. *Plant associations of the Alpár meadow* (BODROGKÖZY 1967):
   1. *Salvio-Festucetum sulcatae*
   2. *Caricetum gracilis*
   3. *Carici-Menyanthetum*

III. *The plant association of Tőserdő*
   1. *Fraxino pannonicae-Alnetum*

The plant associations at ground level have not developed in the forest owing to the shading effect of the crown of leaves. At deeper levels on the marshy clearings, resp. in the forest along the ways we cannot speak of any developed plant associations.

Evaluation of the results of the investigation

There were collected 111 Apoidea species from the areas investigated. From among these 58 were collected on Körtvélyes-Island, 49 in Alpár meadow, and 69 in Tőserdő. In the list of species (Table 1) the faunistically rare species are enumerated. There are ranked as such rare species in the Carpathian basin the *Macropis labiata* F. collected on Körtvélyes Island, as well as *Andrena argentata* SM. (MÓCZÁR, L.–WARNCKE, K. 1972), *Ammobates vinctus* GERST., *Epeolus fasciatus* FRIESE, and *Epeoloides coecutiens* F., occurring in the Alpár meadow.

It is proved by climatological investigations that the temperature of flood-plain clearings is higher than that of the adjacent areas of the Great Plain (ANDÓ 1959). It may be imagined that the large number of the thermophilous species in the areas investigated can be explained, in some degree, also with this (Table 3). At the evaluation of the ecological distribution of species, in all the three areas, the thermophilous species and those of large ecological amplitude amount to more than 3/4 part of the Apoidea population.

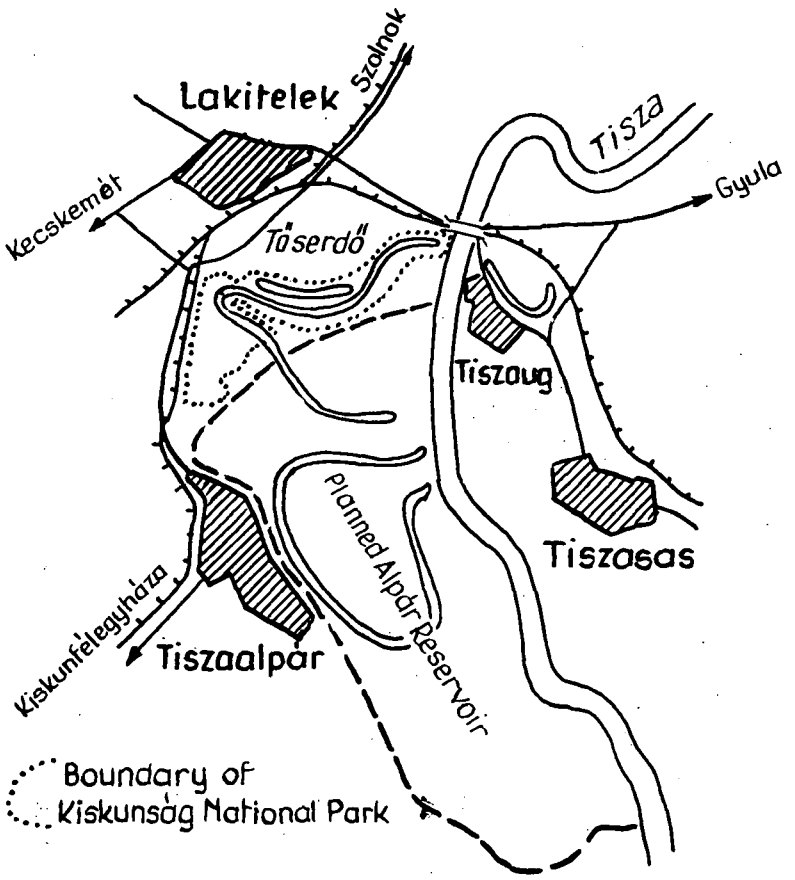

Fig. 2. Map of the area investigated (Alpár meadow, Tőserdő).

The number of Apoidea species occurring in the area of collection is closely connetced with the richness of vegetation, resp., to a certain extent, with the number of the collecting days. The richness of vegetation is a function of the dates and lastingness of flood-waves. The species number of the Apoidea insect population is directly proportional to the richness of the vegetation depending on the flood-waves. In the time of the spring flowering aspect, Körtvélyes Island was covered by flood-waves in 1975, 1976, and 1977. the genera of the early spring and early summer osmia and Eucera are, therefore, completely missing from the fauna. The level of the Alpár

Table 1. *Apoidea species of the sites investigated*

Species	Körtvélyes Island (1)		Alpár meadow (2)		Tőserdő (3)	
	♀	♂	♀	♂	♀	♂
	1.	2.	3.	4.	5.	6.
Prosopis cornuta SM.	+					
P. annularis K.	+					
P. angustata SCHCK.	+	+				
P. gracilicornis MOR.		+				
P. brevicornis NYL.	+					
P. gibba SAUND.		+			+	
P. euryscapa FÖRST.		+				
P. confusa NYL.						+
P. communis NYL.				+	+	+
Colletes daviesanus SM.			+	+	+	+
Melitta tricincta K.	+	+			+	+
M. nigricans ALFKEN	+	+		+	+	+
M. leporina PZ.				+		+
Macropis fulvipes F.			+			
M. labiata F.		+				
Dasypoda plumipes PZ.	+			+	+	+
Andrena seminuda F.			+			
A. falsifica PERK.			+		+	
A. labiata F.			+	+		
A. limata SM.			+			
A. haemorrhoa F.			+			
A. hypopolia SM.			+			
A. argentata SM.			+			
A. helvola L.			+			
A. flavipes PZ.	+	+	+	+		
A. labialis K.				+	+	
A. ovatula K.	+	+	+		+	+
A. cordialis MOR.	+					
A. tibialis K.	+					
Nomada fucata PZ.		+				
N. flavopicta K.	+	+				
Ammobates vinctus GERST.			+			
Halictus simplex BLÜTHG.	+	+			+	
H. 4-cinctus F.	+	+				
H. veneticus EBMER	+	+				
H. maculatus SM.	+	+			+	
H. eurygnathus BLÜTHG.		+				
H. subauratus (ROSSI)	+	+	+	+	+	+
H. perkinsi BLÜTHG.	+		+		+	
H. kessleri BRAMS.	+					
H. geminatus PÉREZ	+					
Lasioglossum leucozonium (SCHCK.)	+					+
L. morbillosum (KRIECHB.)	+					
L. zonulum (SM.)		+			+	
L. 4-notatulum (SCHCK.)	+	+				
L. punctatissimum (SCHCK.)		+				
L. puncticolle (MOR.)		+				
L. nitidiusculum (K.)		+				
L. malachurum (K.)	+	+			+	+
L. calceatum (SCOP.)	+		+			+
L. albipes (F.)	+		+			
L. villosulum (K.)	+					
L. nigripes (LEP.)		+				

L. laticeps (SCHCK.)			+			
Rhophitoides canus Ev.					+	
Megachilis ericetorum lep.						+
M. willoughbiella K.						+
M. centuncularis L.	+			+	+	
M. argentata F.				+	+	
M. rotundata F.				+	+	
M. melanopyga COSTA					+	
M. rubrimana MOR.	+					
M. pilidens ALFKEN		+				
Lythurgus chrysurus FONSC.				+	+	+
Osmia aenea L.			+	+	+	+
O. bicolor SCHRK.			+			
O. aurulenta PZ.					+	
O. rufa L.					+	
O. atrocoerulea SCHILL.					+	+
O. spinulosa K.					+	
Eriades maxillosus L.				+		+
E. emarginatus NYL.					+	
E. truncorum L.	+	+	+	+	+	+
E. crenulatus NYL.					+	+
Anthidium strigatum PZ.		+			+	
A. florentinum F.	+				+	+
A. tenellum MOCS.	+		+	+	+	
A. lituratum PZ.	+	+				+
A. manicatum L.					+	
Coelioxys elongata LEP.	+					
C. acuminata NYL.	+			+	+	+
C. rufocaudata SM.					+	+
C. brevis EV.						+
C. aurolimbata FÖRST.			+		+	
Stelis aterrima PZ.					+	
Tetralonia nana MOR.	+		+		+	
T. ruficornis F.	+	+	+	+	+	+
T. salicariae LEP.	+	+				
Eucera nigrifacies LEP.					+	+
E. clypeata EV.			+	+	+	+
E. pollinosa SMITH					+	
E. tuberculata F.				+	+	
Anthophora crinipes LEP.						+
A. furcata PZ.	+				+	+
A. acervorum var. *squalens* DOURS.					+	+
Epeolus fasciatus FRIESE			+			
Epeoloides coecutiens F.			+			
Xylocopa cyanescens BRÜLLÉ					+	
X. violacea L.					+	
Ceratina cyanea K.			+		+	+
C. nigroaenea GERST.					+	
Bombus lucorum L.						+
B. belferanus SEIDL.			+		+	+
B. silvarum distinctus VOGT	+	+		+	+	+
B. derhamellus K.		+	+	+	+	+
B. lapidarius L.			+	+	+	+
B. terrestris L.	+	+	+		+	+
B. agrorum F.		+	+	+	+	+
B. muscorum F.					+	+
Psithyrus rupestris F.				+		+
Apis mellifica L.	+	+	+	+	+	+

Table 2. *Connections of the flower-visiting wild-bee population of the areas investigated*

Körtvélyes Island (1)			Alpár meadow (2)			Tőserdő (3)		
Plant species	N	P	Plant species	N	P	Plant species	N	P
Thalictrum flavum		+	*Ranunculus repens*	++		*Consolida orientalis*	+	+
Rubus caesius	++		*Thalictrum lucidum*		+	*Ranunculus sp.*	++	
Glycyrrhiza echinata	++		*Potentilla reptans*	+	++	*Thalictrum lucidum*		+
Vicia cracca	++	+	*P. anserina*	+	++	*Rubus caesius*	++	
Lythrum salicaria	++	+	*Medicago lupulina*	++	+	*Trifolium aureum*	++	+
L. virgatum	++	+	*Trifolium hybridum*	++	+	*T. repens*	++	+
Euphorbia lucida	++		*T. pratense*	++	+	*Tetragonolobus siliquosus*	++	+
Symphytum officinale	++	+	*Lotus corniculatus*	++	+	*Lotus corniculatus*	++	+
Prunella vulgaris	++	+	*Coronilla varia*		++	*Coronilla varia*		++
Stachys sp.	++	+	*Vicia cracca*	++	+	*Vicia faba*	++	+
Mentha aquatica	++	+	*Euphorbia lucida*	++		*V. cracca*	++	+
Matricaria inodora	+	++	*Lythrum salicaria*	++	+	*V. villosa*	++	+
Chrysanthemum vulgare		++	*L. virgatum*	++	+	*Lythrum salicaria*	++	+
Inula britannica	+	++	*Calystegia sepium*	+		*L. virgatum*	++	+
Crepis sp.	+	++	*Symphytum officinale*	++	+	*Galium verum*		+
Lysimachia nummularia		+	*Prunella vulgaris*	++	+	*Asclepias syriaca*	++	+
			Stachys palustris	++	+	*Glycyrrhiza echinata*	++	
			Mentha aquatica	++	+	*Daucus carota*	+	
			M. arvensis	++	+	*Symphytum officinale*	++	+
			M. pulegium	++	+	*Knautia arvensis*	+	+
			Plantago major		+	*Scabiosa ochroleuca*	+	++
			Mactricaria inodora	+	++	*Althaea officinalis*	+	++
			Taraxacum officinale	+	++	*Malva silvestris*	+	+
			Lysimachia nummularia		+	*Euphorbia lucida*	++	
			L. vulgaris		+	*Echium vulgare*	++	
			Inula britannica	+	++	*Verbena officinalis*	+	
						Glechoma hederacum	++	+
						Prunella vulgaris	++	+
						Lamium purpureum	++	+
						Ballota nigra	++	
						Linaria vulgaris	++	+
						Rorippa silvestris	+	++
						Stenactis annua	+	++
						Erigeron canadensis		+
						Inula britannica	+	++
						Matricaria inodora	+	++

Chrysanthemum vulgare		++
Carduus acanthoides	++	+
C. nutans	++	+
Cirsium canum	++	+
Centaurea sp.	++	+
Cichorium intybus	++	+
Crepis sp.		+
Melandrium album	+	+
Chenopodium album		+
Muscari racemosum	++	

Note: N=necter, P=pollen. The comparatively more nectar, resp. pollen production is marked by ++.

meadow is higher than the area mentioned above. Thus the water mass is smaller in the time of flood-waves and passes sooner. The vegetation sooner regenerates than on the deeper lying Körtvélyes Island. From the area surveyed at Tőserdő only the parts bordering on the Alpár meadow were covered with water in the time of flood-waves. Here means the vegetation in annual cross-section a continuous pollen and nectar source for Apoidea. From the point of view of the connection of Apoidea with nutritive plants, the vegetation is here the richest (Table 2). The connections with nutritive plants are the primary determinants of the formation of the Apoidea fauna. In the higher lying flood-plain areas, getting not under water-covering, the bulk of the flower-visiting insect population is represented in Spring by the species of the *Andrena, Halictus, Osmia, Anthophora,* and *Bombus* genera. The melliferous weeds of the Taraxacum officinale and Labiate families have served for nutritive sources. Such plants are: *Lamium purpureum* and *Glechoma hederacum.* Particularly the individuals of *Bombus agrorum* F. visited these two plant species with a special predilection at Tőserdő in Srping. Apart from labiates, the papilionaceae are very good melliferous plants (HALMÁGYI–KERESZTESI 1975). The *Vicia* species, having extrafloral nectar glands, as well, serve first of all as nectar sources for Apoidea in May and June. At Tőserdő, *Vicia cracca* and *V. villosa* served as a rich nectar source for the individuals of *Eucera clypeata* EV., *E. nigrifacies* LEP., *E. pollinosa* SMITH. The

Table 3. *Evaluation of the flower-visiting Apoidea population, according to ecological types of distribution*

	Körtvélyes Island (1)		Alpár meadow (2)		Tőserdő (3)	
	species	percent	species	percent	species	percent
Thermo- and xerophilous	22	37.93	20	40.82	31	44.93
Indifferent	23	39.66	18	36.73	23	33.33
Hygro- and psychrophilous	10	17.24	6	12.24	14	20.29
Not evaluated	3	5.17	5	10.21	1	1.45
Sum total	58	100.00	49	100.00	69	100.00

flowers of *Vicia faba* were visited by the *Xylocopa* species. In the flood-plains, *Vicia cracca* began flowering after the passing of flood-waves, in midsummer. Its flowers were visited in the Alpár meadow by the individuals of *Eucera clypeata.* In midsummer, in the flood-plains, apart from the Lythrum species, the Compositae species, giving mostly but little nectar, represent a considerable part of vegetation. The Compositae — apart from some melliferous species, like *Carduus nutans, C. acanthoides,* exerting an attractive effect on the *Halictus* and *Lasioglosum* species — first of all produce pollen (GULYÁS–PESTI 1966). At Tőserdő, the *Halictus* and *Lasioglossum* species were attracted by the *Carduus* species. In the Alpár meadow and on Körtvélyes Island, the *Crepis* species and *Matricaria inodora* were visited by the individuals of *Halictus subauratus* (ROSSI), H. *perkinsi* BLÜTHG. On Körtvélyes Island and in the Alpár meadow, at the deeper levels, the melliferous *Lythrum* species serve to the *Melitta nigricans* ALFKEN, *M. tricicta* K., *Tetralonia salicariae* LEP. species for a pollen and nectar source in July and August. In this time, in the flood-plains, the best melliferous plants of the area, *Symphytum officinale* and *Vicia cracca* form bushes.

In midsummer, in the flood-plains, 80 to 90 percent of the pollen and nectar production is supplied by the Lythrum and Compositae species for Apoidea. At the end of September, owing to the considerable decrease in food, there flew only the *Bombus* species of long flying radius and of considerable metabolic process, as well as their parasites and a few *Halictus* and *Lasioglossum* species.

In the Alpár meadow and first of all on Körtvélyes Island, because of the flood-waves, and depending on the level, no richer vegetation developed. The water-cover and silting up of 2 to 4 m is tolerated but by few plants. The vegetation generally regenerates in 3 to 5 weeks. The species combination of vegetation is the most poor on Körtvélyes Island having the deepest level (Table 2). The vegetation is the most varied from among the areas investigated at Tőserdő, with the highest level. The Apoidea fauna is here the richest in species.

In the course of the flower-visiting observations, a contradiction appeared between the nectar production of some plant species and the flower-visitation of Apoidea. The Melandrium album is melliferous, what is confirmed by literary data, as well. The Apoidea visit it, on the other hand, according to my observations, hardly, because the nectar is sucked out by the nocturnal moths. *Linaria vulgaris* is melliferous but the corolla close to the nectarium is gnawn out by the *Bombus terrestris* workers and thus the secondary nectar-predatory honey-bee can get nectar through the corolla gnawn through. The *Mentha* species are visited by honey-bees with great predilection. Its nectar-secretion is great, its sugar content is, however, low. The plants of the Compositae family produce first of all pollen. The *Prosopis* species visited, according to my observations, first of all the flowers of *Inula britannica, Matricaria inodora* bringing little nectar. Here they stayed for a rather long time. These Apoidea swallow down pollen, having no organ for collecting (MÓCZÁR 1960). The flowers of *Coronilla varia* are visited by the *Andrena, Halictus, Lasioglossum* species. They collect pollen because they have no nectar gland.

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Az Alsó-Tisza folyamszakasz védett hullámtéri területei méhalkatú rovarnépességük és tápnövény kapcsolataik

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Kivonat

A megvizsgált területről 111 méhalkatú fajt gyűjtött be a szerző. A hullámtereken a méhalkatú rovarnépességek fajgazdagsága a tápnövénykapcsolatokra vezethető vissza. A vegetáció fajkombinációja a térszint magasságtól, valamint az árhullámok elhúzodásától, illetve időpontjától függ.

Zavisnost izmedju populacija Apidae i biljki hraniteljki na plavnom području donjeg toka reke Tise

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Abstract

Sa ispitivanog područja autor je prikupio 111 vrsta Apidae. Na plavnim područjima bogatstvo vrsta populacija Apidae zavisi od biljki hraniteljki. Kombinacija vrsta u odnosu na sastav vegetacije zavisi od nivoa biotopa, kao i od vremena prestanka plavljenja.

Пчёлообразные насекомые, их связь с питающими растениями на пойменных защищённых территориях нижнего течения Тисы

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Резюме

С исследуемой территории автору удалось собрать III видов пчелообразного типа. Большая видовая разнообразность пчелообразных насекомых на поймах связана с их отношением шая видовая разнообразность пчлообразных насекомых на поймах связана с их отношением к питающим растениям. Видовая комбинация вегетации зависит от высоты рельефа, от времени и продолжительности павиоков.

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THE AUTUMN MIGRATION OF THE BALCKCAP (SILVIA ATRICAPILLA L.) IN THE DANUBE-BEND

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Abstract

The autumn migration of the blackcap was investigated in the ringing camp of the Hungarian Ornithological Association, in Kisoroszi (47° 47' N; 19° 03' E), in the years 1974–1976. Using wing and tail sizes, multivariate analysis was carried out and the regression of wing length, resp. wing pointedness calculated, shown by the date of passage. Relying upon these findings, the population composition of the migratory birds and the migration dynamics of populations were discussed and biometric data published. By means of regression analysis, some differences can be demonstrated in the migration behaviour of sexes.

Introduction

The blackcap *(Sylvia atricapilla)* is, after whitethroats *(S. communis)* being strikingly reduced in numbers (WINSTANLEY, SPENCER & WILLIAMSON 1974, STOLT & ÖSTERLÖF 1975), our most frequent warbler species today. We know from migration data and experiments (BERTHOLD & DORKA 1969, BERTHOLD, GWINNER & KLEIN 1970, KLEIN, BERTHOLD & GWINNER 1971, 1973, BERTHOLD 1976, ZINK 1973) that the balckcap has no definite instinct migration programme. According to the wintering area, the European populations can be divided as follows: north of 52°-N, the nesting birds migrate in a broad front (Breitfrontzug) towards the south, in the direction $188° \pm 27°$. At the nesters south of 52°-N and east of 15°-E, the direction of migration is $142° \pm 18°$, at those west of 15°-N it is 196° (E = 0°). The most crowded gathering place is the Near-East, from where a part of them keep on migrating to Africa. The migration in Eastern Europe begins and ends earlier than in Western Europe begins and ends earlier than in Western Europe where the migration peak of the spring migration is 0.84 days late annually and that of the autumn migration advances about 0.54 days. The cause of this may be that since the Nineteen-Fifties the blackcap became more numerous in Europe. And, as first those nesting in more northern places do migrate and then those nesting in more southern places, this brought about a change in their migration peaks. In the wintering areas, the northern nesters can be found at the southern fringes, and those being more eastward in the nesting sites, preserve their more eastern situation in the wintering areas, as well.

* Researches of the Hungarian Ornithological Association, Proceeding 2.

All these are mostly founded on data obtained from Northern, Central and Western Europe. About the populations in Eastern Europe there are only sporadic informations. There have so far been only nine Hungarian ringed blackcaps reported back, all of these from the Near-East and Cyprus. It is to be expected on the basis of the foregoing that there migrate more European populations into their winter-quarters over this country, possibly along the Danube (KLEIN, BERTHOLD, GWINNER 1973).

Although from the Nineteen-Sixties many publications have dealt with the biometric elaboration of the migration of birds (e.g. SCOTT 1962, BUSSE 1968, 1972a, 1976b, NIEMEYER 1969a, b, BLONDEL 1967, etc.), these were generally made with an univariate analysis. There were only a few attepts with taking into consideration together more than one point of view (BUSSE 1968, 1976a).

In my work, there were taken into consideration five sizes at the biometrical evaluation. These were evaluated together, with what the safety of separating the single populations could be increased well.

From among the biometrical elaborations the older data can generally not be used because the majority of these were recorded from specimens in museums and another method was used (SVENSSON 1972, WILLIAMSON 1972). I deemed it, therefore, useful to publish the measured biometric characteristics, as well.

Materials and Methods

The material of investigation was collected in Kisoroszi (47° 47' N; 19° 03' E), at the northern point of the Szentendrei-Island, by the collective, working in the ringing camp of the Hungarian Ornithological Association. It consists in the Autumn of 1974/1975 collected and measured 290 blackcaps. The birds were captured with mist nets laid in three phytocoenoses of the area: (1) *Salicetum triandrae* willow beds, (2) *Pruno-spinosae-Crataegetum* hawthorn bush, and (3) *Festuco-Pinetum* pinewood plantation. There were used nets of different productions and sizes but of identical mesh sizes (15×15 sq. mm), with a total surface changing between 135–640 sq. m. Their ratio was the same in the single coenoses, in the former sequence 3:2:1.

At controlling and measuring, the methods of the Baltic Action were followed BUSSE & KANIA 1970, BUSSE 1974). There were measured, resp. recorded: the assessed condition (this was measured only in 1976), the wing length, tail length, the quantitative wing formula, the distance between the longest primary and the first secondary, the difference between the first primary and the primary coverts (being positive if the primary is longer). Bill and tarsus were not measured because of technical causes.

At the biometric evaluation those described by BUSSE (1972b) were followed. The elaborateness of distribution was restricted by the existing size of samples. The comparison between the groups was carried out by Hotelling's T-square test (TATSUOKA 1971). The other calculations were performed on the basis of SVÁB (1967).

Results and their discussion

The blackcap migrates in the night. The course of its migration was concluded from the number of those captured. From the graph of capturing (Fig. 1) three waves could be separated, coinciding year by year:

	I	II	III
1974	24 August–4 Sept.	5–18 Sept.	—
1975	18 August–4 Sept.	5–13 Sept.	14–30 September
1976	20 August–3 Sept.	4–12 Sept.	13 Sept.–9 August.

It is to be noted that the beginning of wave I is the day of the opening of the camp and not a real day of commencement. In the same way, in 1974, the end of wave II was on the 18th because of closing the camp. In 1974, there are measurement data only after the first of September.

At the investigation of BERTHOLD, BAIRLEIN and QUERNER (1976), structure and size of collecting were already considerably changed by transferring or omitting a net. From the map published by them is, anyway, to be seen that comparatively few nets were laid under varied conditions of phytocoenoses. Their reservations cannot be accepted in our larger homogenous phytocoenosis-units. We have used constant net sites but the nets lay in alternating numbers of these. The structure of collecting can be considered as similar, this was not influenced by the alternating number of nets. The data of collecting were corrected to the net surface (Fig. 1).

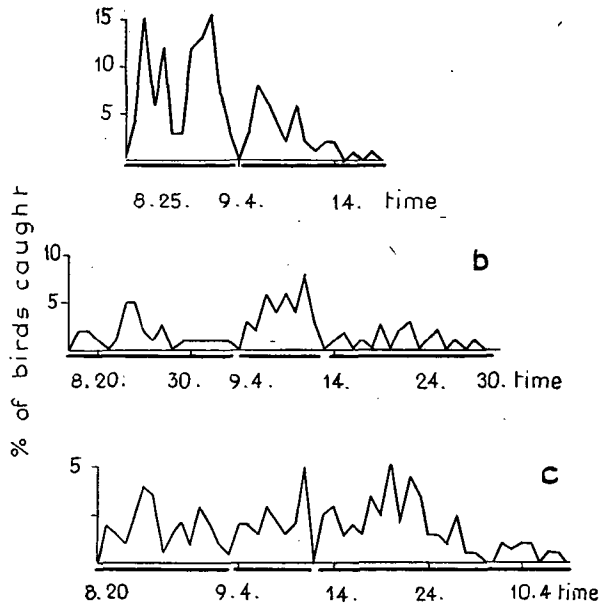

Fig. 1. Autumn migration of blackcap at Kisoroszi. a : 1974, b : 1975, c : 1976. Results are corrected to net surface.

The migration curve gives well-separable waves which were further on treated as a unit. Although the curve of the single waves is of normal distribution for all the variables investigated, it still did not consist, in some cases, of a single population.

Such a situation has already been known since an earlier date (BUSSE, 1976a, LÖVEI 1977.)

The matter in question is, in this case, the investigation of the morphological variation. It was namely supposed on the basis of previous researches that populations originating from different geographical sites may migrate over the area investigated. The selection of the statistical differences between populations, resp. of the factors showing these differences would require the previous investigation into several (40 to 60) morphological characters (THORPE 1976). This is possible in case of investigating into a museum material. In case of living birds, however, the number of measurable data is restricted by the intention of releasing them undamaged and by the large number of birds during the unit of time.

Starting from this consideration, we have applied the widely accepted measuring methods of the Baltic Action (BERTHOLD 1973, BUSSE 1974). The effectiveness of investigations can be increased if the factors exposed to the adaptative pressure are investigated. These are, in case of birds, at least the wing, the bill, and the tarsus: The last two factors have not been measured. But in case of the wing, four sizes were stated that were earlier suggested for characterizing wing pointedness (AVERILL 1920, 1925, RENSCH 1938, STEGMAN 1940, 1954, 1961, 1962, KIPP 1958, 1959, HOLYNSKI 1965).

It is to be supposed that a more pointed wing means an adaptive advantage and that this pointedness is proportionate to the distance made during migration, if only the way of taking nourishment does not demand much flying (like e.g. at swallows) and if the populations of the species live in different parts of the area of spreading, in similar habitats and take similar nourishments, i.e. if, apart from the time of migration, there is no significant difference in the energetics of populations.

It is also supposed that the first-year birds obtain, for the date of migration, the wing pointedness characteristic of the population, if only there is no difference in the migration behaviour of age-groups (cf. a proper example for that at KIPP, 1954).

Blackcaps are insectivores living in bushy habitats. The richness in species of the potential food, its mean size and size pattern do not show, at least, a gradient increasing in northern direction. The energy devoted to taking nourishment does, therefore, not decrease in northern direction (SCHOENER & JANZEN 1968), SCHOENER 1971). We think, therefore, that the distance made at migration is a considerable force in the determination of the wing pointedness of the European blackcap population. This means, in accordance with the data up till now (KLEIN, BERTHOLD & GWINNER, 1973) that in the north the wings of blackcaps are more "pointed" because the northerners must fly much more to the wintering sites and back.

For investigating the mechanism of migration, there was carried out the regressive investigation of the wing length and Holynski's wing-pointedness index (e-value, HOLYNSKI 1965), during the autumn migration (Figs. 2–5) and these were compared with the data of KLEIN, BERTHOLD & GWINNER (1973). A better result is obtained by investigating into the wing pointedness than into the wing length (Table I). The migration mechanism published by KLEIN, BERTHOLD & GWINNER (1973) is confirmed by the regressive straights concerning layers. Wing pointedness gives a much steeper regressive straight (Table I) than according to the mentioned publication (Table 7, Figs. 22, 23 in KLEIN, BERTHOLD, & GWINNER, 1973).

Table I. *Sylvia atricapilla*, Kisoroszi, 1974–1976. Reggression analysis, showing the connection of the mean wing length and wing pointedness with the date of migration

Sex	Measurement	b	r	p for $r \neq 0$	Confidence limits 5 p. c.	1 p. c.
Male	wing length	0.0717	0.3649	<0.001	±0.2528	±0.3333
	wing pointedness	0.3995	0.2148	<0.01	±0.3029	±0.3993
Female	wing length	−0.0946	−0.5197	<0.001	±0.0832	±0.1096
	wing pointedness	−0.2523	−0.3625	<0.001	±0.0786	±0.1036

At males, both wing length and wing pointedness give a regressive straight of positive steepness differring from zero significantly (Table I, Figs. 2–3), what refers to the different migration mechanism of males.

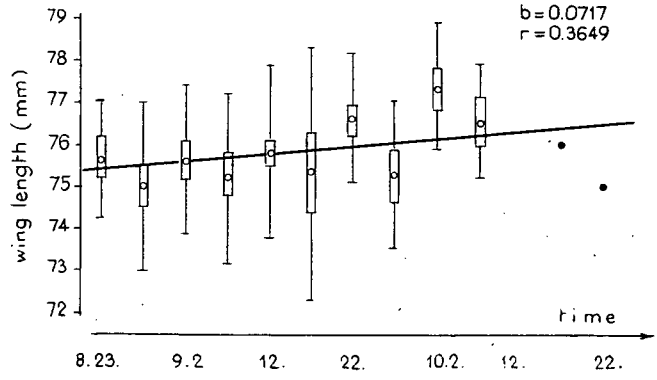

Fig. 2. The mean size of the wing length of the male blackcaps, with mean failure and size pattern per 5 days.

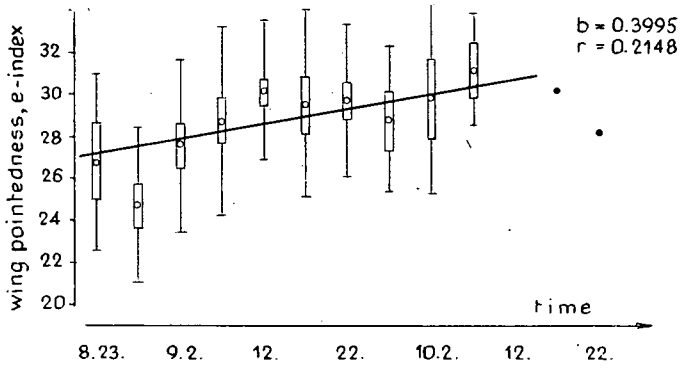

Fig. 3. Change in the wing pointedness of the male blackcaps, like in Figure 2.

Table II. *Sylvia atricapilla*, Kisoroszi, 1974–1976. Biometric evaluation of the recorded sizes, separated in years, waves, and sexes, at 95 percent confidence level. Data: the mean size ± size pattern (above); size pattern, sample size (below)

Year, wave, sex	lst primary	Wing length	Tail length	Primary-secondary distance	Wing pointedness, e-index
♂, I.	4.00±1.60	76.00±1.42	63.38±1.26	20.14±1.46	29.86±3.48
	1.73 7	1.69 8	1.51 8	1.57 7	3.76 7
	3.38±0.91	74.88±0,93	62.71±0.96	18.88±0.64	28.53±2.47
II.	1.71 16	1.80 17	1.86 17	1.20 16	4.45 15
♀ I.	5.00±1.76	74.83±1.72	61.83±2.34	19.50±1.45	30.33±4.44
	1.67 6	1.72 6	2.23 6	1.38 6	4.23 6
1974 II.	3.75±1.05	76.17±1.40	63.36±1.05	18.92±0.96	29.64±1.57
	1.66 12	2.21 12	1.57 11	1.51 12	2.34 11
♂ I.	3.25±0.86	74.00±0.86	63.46±1.74	18.33±0.49	24.64±2.41
	1.36 12	1.35 12	2.58 11	0.78 12	3.58 11
II.	3.40±0.55	75.67±1.04	63.47±0.75	19.80±0.76	29.53±2.54
	0.99 15	1.88 15	1.36 15	1.37 15	4.58 15
III.	3.78±1.26	76.33±1.39	63.89±1.94	19.89±1.46	29.44±2.96
	1.64 9	1.80 9	2.52 9	1.90 9	3.84 9
♀ I.	2.90±1.10	75.00±1.35	63.40±1.48	19.70±0.48	27.36±2.02
	1.64 11	2.00 11	2.07 10	0.68 10	3.01 11
II.	4.40±1.02	75.07±1.10	63.33±1.06	19.67±0.65	29.92±2.47
	1.84 15	1.98 15	1.92 15	1.18 15	4.09 13
1975 ♀, III.	3.33±0.95	75.50±1.31	63.92±1.54	20.17±0.37	27.18±3.12
	1.50 12	2.07 12	2.43 12	0.58 12	4.64 11
♂, I.	3.77±0.95	75.82±0.79	63.27±0.78	18.64±0.50	26.65±1.96
	2.14 22	1.79 22	1.75 22	1.14 22	4.20 20
II.	4.44±0.57	75.83±0.96	62.78±0.93	19.42±0.56	30.00±1.27
	1.31 23	2.26 24	2.15 23	1.32 24	3.01 24
III.	3.86±0.51	76.06±0.70	63.77±0.73	20.03±0.50	29.69±1.24
	1.52 36	2.06 36	2.09 34	1.45± 35	3.66 36
♀, I.	4.37±0.57	76.00±0.59	63.57±0.76	19.13±0.60	30.11±1.48
	1.52 30	1.61 31	2.05 30	1.61 30	3.82 28
1976 II.	3.65±0.50	76.65±0.71	64.43±0.76	19.48±0.67	31.09±1.62
	1.15 23	1.64 23	1.75 23	1.56 23	3.65 22
III.	3.50±0.45	76.11±0.82	64.08±0.76	19.73±0.43	29.36±1.32
	1.34 36	2.45 37	2.28 37	1.28 37	3.91 36

The migration waves and within them the differences of sexes were investigated with multivariate analysis. The safeness of separation increased by two orders of magnitude opposite to the method using wing pointedness (LÖVEI 1977). The mean level is $p=0.001$ and the differences are even at this level in most cases very significant.

The comparison of the various waves originating from different years has generally shown significant differences but sometimes random connections. It has been confirmed by this that the investigation into samples originating from different years leads to results of very changing and uncertain value. The causes of differences may equally be the different meteorological factors, inner controlfactors, the dissimilar mortality of populations, successful nesting or a mere chance. What is to be concluded from this investigation is only that the groups of males less differ from one another than those of layers. The cause of this may be not the smaller variability of males (it is, in fact, not smaller, cf. Table II) but that male migration is more influenced by external conditions than that of layers.

At investigating into the different waves, it is obvious that there is often a significant difference between males and layers, caught in the same wave, which is greater than, e.g., the difference from a previous group. This can most of all be seen in the year 1975 (Fig. 6). It is to be mentioned, too, that if in an area the males of a population migrate then — if both layers and males migrate in the same way — the layers of the population migrate in the same place, as well.

At the beginning of encampment the males did not migrate, as yet. Wing length and wing pointedness were equally of low value, similarly to that at the end of migra-

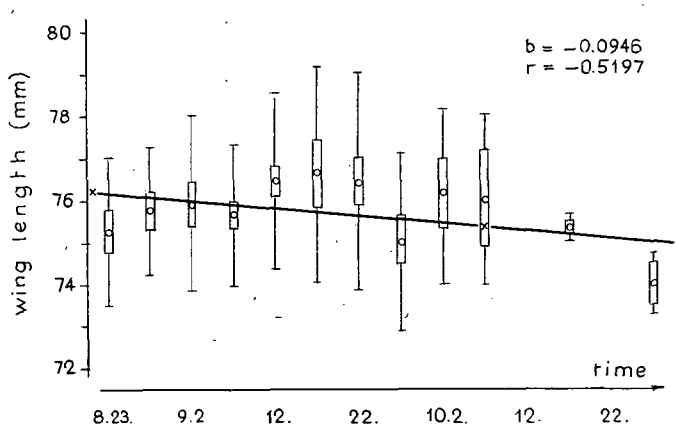

Fig. 4. Change in the wing length of the layer blackcaps, like in Figure 2.

tion (Figs. 2, 3, Table II). At the layers, there is already present a migrating population what is confirmed by that they differ from the males belonging to the same wave ($p<0.001$). Wave III, however, shows a significant difference from both the first ($p<0.01$) and the second ($p<0.05$) layer waves, while the difference between male and layer waves III is not significant ($p>0.1$). The results of 1974 and 1976 may be evaluated in a similar way.

I try to summarize the population pattern as follows: population 1 is represented by the males of wave I. These have been present in the area during the whole time of investigation. But the local males are "oppressed" by the higher number of those

arriving in populations 2 and 3 and connot be observed later. By the males of wave II, population 2, and in a smaller part population 3, are represented. In wave III, population 3 dominates but, in smaller ratio, members of populations 2 and those of population 1 are also present.

In case of layers, in wave I, population 1 (local nesters) and, in the majority, population 2 are present, in wave II populations 3, 2, and 1, while in wave III the layers belonging to populations 3 and 1 migrate. Denseness of the nesting population is smaller and this is visible in case of layers, as well.

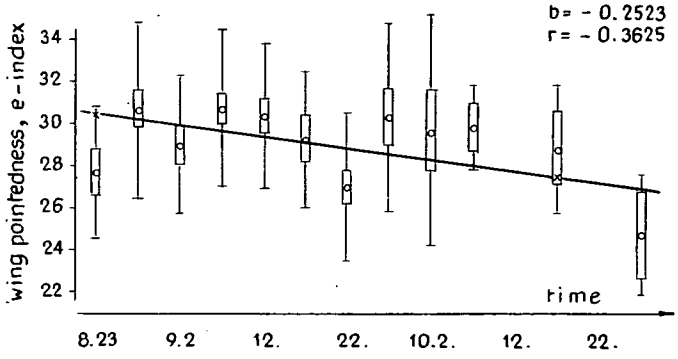

Fig. 5. Change in the wing pointedness of the layer blackcaps, like in Figure 2.

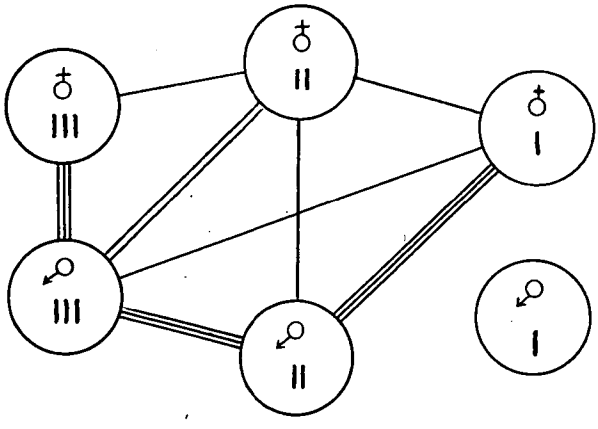

Fig. 6. Differences between the autumn migration waves with multivariate variance-analysis, 1975, Kisoroszi. I, II, III: migration waves. There is no junction-line. There is a significant difference at levels=0.001; - $p<0.01$; =$p<0.05$; $p>0.1$

The regressive straight of males was correspondingly found having a positive ascent because, at the beginning of the time of investigation, there were no male migrants. The regressive straight, started in about a fortnight after the beginning of the camp, was already negative because until that time so many migrants had arrived that the average was already influenced by their sizes.

Conclusions

As seen above, the interpretation of migration, the analysis of the migration dynamics of populations are much more difficult tasks than those over the Baltic seaside. With us, mixed populations are present but the migration is not so massive as at the traditional European migration points.

The multivariate analysis is a serviceable method to separate populations. Mention must be made, however, of that in case of large samples there are given "too significant" differences, e.g. between any male-layer groups significant differences are calculated but that is biologically unacceptable.

It can be supposed on the basis of the structure of migration, of size and heterogenous populations of waves that the populations caught at Kisoroszi did not show a typical migration curve, resp. that they interferred very much. The definite, from the point of view of population homogenous waves are missing, there cannot be observed any concentrated migration. The demonstrated populations either arrived from a not great distance or their migration was not concentrated by the valley or gallery forests of the Danube. It is imaginable that the populations arriving, so far, concentrated, scatter in the forests of the Danube-bend. The investigations should, therefore, be continued at a more southern point. On the basis of the results until now, the hypothesis of Klein, Berthold, and Gwinner cannot be considered as proved.

The regressive investigations performed according to sexes have demonstrated some differences in scheduling migration, the cause of which is to be looked for in the differences in force of the instinct migration programme.

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A barátposzáta (Sylvia atricapilla L.) őszi vonulásáról a Dunakanyarban

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Kivonat

A barátposzáta őszi vonulását vizsgáltuk a Magyar Madártani Egyesület gyűrűzőtáborában, Kisorosziban (47° 47' N; 19° 03' E), 1974—76-ban. A szárnyról és a farokról vett méreteket használva többváltozós analízist végeztünk és a szárnyhossznak, illetve a szárnyhegyességnek az átvonulás időpontjával mutatott regresszióját számoltuk ki. Ennek alapján megvitattuk a vonulók populáció-összetételét, a populációk vonulásdinamikáját, és biometriai adatokat közöltünk. A regresszióanalízissel különbség mutatható ki az ivarok vonulási viselkedésében.

Jesenja seoba Sylvia atricapilla L. na području Dunakanyar

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Abstract

Tokom jeseni 1974—1976. god., u okviru rada Ornitološkog udruženja za prstenovanje ptica, pratili smo seobu *Sylvia atricapilla* L. na području Kisorosz (47° 47' N; 19° 03' E). Koristeći merističke podatke (dužina krila i repa) izvršena je analiza dužine krila, odnosno izračunata je regresija zašiljenosti krila u vreme seobe. Prikazujući biometrijske podatke analiziran je sastav i dinamika populacija u seobi. Na osnovu regresione analize utvrdjena je razlika u ponašanju polova pri seobi.

Об осеннем улёте Sylvia atricapilla в извилине Дуная

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Резюме

В лагере в Кишороси при Венгерском птицеводческом Обществе (47°47'; 19°03'E) в 1974—1976 гг. нами изучался осенний перелёт *Sylvia atricapilla*. Используя замеры крыла и хвоста, в нескольких повторностях проделали анализ, подсчитывая регрессию длины и заостренности крыла в зависимости от времени перелёта. На основании этого обсудили состав популяций отлетающих славок, опубликовали биометрические данные. С помощью регрессионного анализа можно установить различие в поведении при перелёте различных полов.

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DATA ON THE SMALL-MAMMALIA FAUNA OF TISZAKARÁD AND ITS ENVIRONS

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(Received 21 June, 1978)

Abstract

The author publishes here the results of his investigations into mammals performed in the environs of Tiszakarád, September through December.

Comparing the data obtained in the course of trapping here with his results in the environs of Szeged, he calls the attention to the somehow different mammalian faunas of the Upper and Lower Tisza Reaches. In the Upper Tisza Region the dominance of *Apodemus agrarius*, in the Lower Tisza Region that of *Apodemus sylvaticus* is established.

The author's observations of ecological character, performed in the course of the investigations in different biotopes, are also contained in the paper.

Aim and method of the investigation

From September up to mid-December, 1974, I stayed in the community Tiszakarád and during this time I also performed mamalogical investigations. Taking into consideration the few literary data published till now on the mammals of the Tisza Region, I think it would not be without interest to publish the results of these researches, without any claim to completeness.

My aim was mainly to come to know the fauna of mammals as completely as possible. I could not investigate into the formation of the population through a complete period of multiplication, however interesting an investigation like this would be, mainly because of the presence of Apodemus agrarius occurring in large numbers. My investigations took place betwen September and December. The dominance relations, to be mentioned in the following, refer similarly to this period. This period shows, at the same time, the most saturated picture of the population.

I have endeavoured, depending on the time at my disposal, to carry aut my collecting work systematically. I have got some data from every month of my staying there. About 15–20 days were spent with collecting. Case-traps, made by myself for catching animals alive, and crushing traps purchased in a shop were used. The collected animals were prepared by myself. They are, at present, to be found in the Bakony Museum of Natural History in Zirc.

Natural geographic conditions

Tiszakarád and its environs belong into the structural unit of Bodrogköz and, within this, to the smaller sub region of the Upper Tisza Region.

The area investigated falls on the alluvial flatland, extending till Zemplénagárd-Tokaj and following the Tisza in a 0.5–6 km broad zone.

Its soil is mainly formed mainly by alluvial formations, resp. meadow-clay farther from the river. Meteorologically it balongs to the moderately warm, moderately dry district of cold winters.

The total annual precipitation is 550–600 mm. It is characteristically poor in snow-cover.

My collection were carried out in the time of the late-summer and early-autumn small-water season, of the late-automn culmination, resp. in the beginning of Winter. In the time of the autumn precipitation maximum, the Tisza overflowed its banks and flooded the area up to the dams. In this period, I could, of course, perform no collections.

It belongs to the hydrographic picture of the neighbourhood, as well, to take into consideration the dead-arm south of Tiszakarád whose picture calls to mind the old Tisza landscape. The Tiszakarád Main Channel, the water of which leads the water surplus of the north eastern part of Bodrogköz through the pumping station at Tiszakarád into the Tisza, flows through our area.

The localization of subsoil water is very high and it often covers large areas.

Description of the collecting sites

I have set my collecting sites in the most characteristic parts of the area and strived to penetrate with my traps into different coenoses. The topographical distribution of the collecting sites are illustrated in the following sketch-map (Fig. 1).

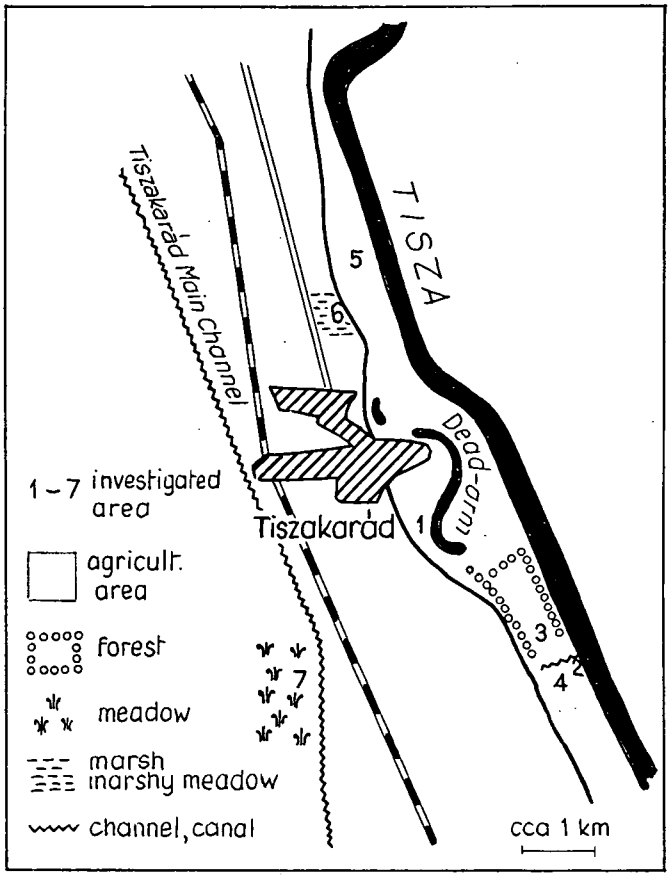

Fig. 1

(a) Areas in the Tisza flood plain

Collecting site 1: about 1.5 km south of the village, at a cut bed-arm. It has shallow water and is richly over grown by a characteristic marshy vegetation, its water-side is bordered by straggling scrub groups (dom.: acacia) of thin undergrowth.

Collected species: *Arvicola terrestris, Mus musculus spicilegus.* In the riparian mud, some traces of *Rattus* and *Vulpes* could be observed. The missing of *Apodemus agrarius* and *Soricidae,* collected in other places in large numbers, is characteristic. This may be explained with the microclimatic conditions (Later, at mentioning the single areas, I will give the serial numbers of these).

Collecting site 2: an area about 2.5 km from the village, divided by a channel flowing into the river. Its soil is sand. Its rich vegetation is flood-plain furrow-weed. Its most characteristic representants are the following: *Chenopodium album, Typhoides arundinacea, Aristolochia clematitis, Echinocystis lobata, Rumex obfusifolius, Urtica dioica, Glechoma hederacum, Polygonum convulvulus,* etc.

The small-mammal stock was concentrated here from the adjacent acacia-, poplar-, and ulmus-*(U. laevis)* -forests *(Ulmo-Populetum)* of small alimentaring ability. The vegetation, treated above, has brought about abundant alimentary, resp. favourable microclimatic conditions, mainly for the *Sorex* and *Apodemus* species from which I could collect some individuals in a very high catching percentage. Control collections were also carried out in this site on 21 and 29 September and 12–13 November. The species found here are: *Talpa europaea, Sorex araneus, Microtus arvalis, Mus musculus spicilegus, Apodemus agrarius, Apodemus sylvaticus, Apodemus flavicollis.*

Collecting site 3: some 100 m far from the former one. It is a corn-field harvested and a fringe coenosis of a forest zone formed by Ulmus, *Populus* species, with high bent-reed.

Demonstrated species: *Talpa europaea, Sorex araneus, Microtus arvalis, Apodemus sylvaticus, Lepus europaeus, Capreolus capreolus.*

Collecting site 4: agriculture, a stack of compost heaped up close to a plough-land, and its environs. The species collected here are: *Mus musculus spicilegus, Apodemus agrarius, Mustela nivalis.*

Collecting site 5: north-east of the village, about 1.5–2 km far from the border of the community. It is a clearing with standing maize. Close to the dam, there is a willow- poplar *(Salicetum albae fragilis)* mixed forest and at the river a thick shrub *(Sambucus nigra, Sambucus ebulus).* It is a biotope representing the present picture of the flood plain well. On the basis of the collections carried out on two occasions (7 and 16 October) it emerges from the individual number of the mammals found here that *Apodemus agrarius* has been dominant: *Sorex araneus* 1, *Mus musculus spicilegus* 6, *Apodemus agrarius* 15, and *Apodemus sylvaticus* 7 individuals.

(b) Areas extending outside the anti-inundation dam

Collecting site 6: an area on the side of the dam, opposite to the river, at the dam foot. The anti-inundation dams are followed ribbon-like by such and similar associations, in a breadth of about 15 to 20 m. These are characteristic humid biotopes, supplied partly by water, oozing through from the flood-plain, partly by that penetrating in the place of the earth dug out in the course of building the dam.

Their vegetation is an uliginous one, Cyperaceae are dominant. Dewberry *(Rubus caesius),* the sarmentose *Potentilla (P. reptans)* and the corn-thistle *(Cirsium brachicephalum)* of small nest and forming a high dry stalk of weed occur fre-

quently. The "marsh zone" is flanked with acacia, elder and other trees, shrubs. It saturation by water is the function of the meteorological conditions. At the date of my investigations (9–10 September 1974) it showed the tendency of drying up.

Demonstrated Mammalia species: *Sorex araneus, Apodemus sylvaticus, Apodemus agrarius.*

Collecting site 7: an area surveyed north-west of the village, along the Tiszakarád Main Channel. It is an original herb remain, protruding into the agrocoenosis (maize-fields), characterized by a soft-stalked vegetation, thickly weaving through the cut old willow and popler trunks. It is mostly constantly covered with subsoil water. In these places, its vegetation is formed by high growing kinds of grasses, bulrushes, etc. This area is islandlike in its environment, assuring hiding-place and food to animals. A result of this is the varied picture of the fauna: *Crocidura leucodon, Sorex araneus, Mus musculus spicilegus, Apodemus sylvaticus, Apodemus agrarius, Micromys minutus.* The observed species are: *Lepus europaeus, Mustela nivalis, Mustela putorius, Vulpes vulpes.* At the channel-side I have observed *Rattus norvegicus* and *Ondatra zibethicus* and also performed here autumn (27, 31 October) and winter collections (11, 12 December).

Evaluation of data, ecological observations concerning species

In this chapter of my paper, I avail myself of the data received by the kind information by GY. CSIZMAZIA, as well as of the results of my investigations carried out in the Tisza Region on the confines of Szeged in 1972–1973 (SZITTA 1974), too. The list of species published here can, of course, not be complete because, for example, animals belonging to the Chiroptera order were not collected.

(1) *Erinacidae*

Erinaceus europaeus roumanicus BARR.-HAMM.

I have not found it within the flood-plain but have often seen its run-over individuals on the subsidiary road at Tiszakarád.

(2) *Talpidae*

Talpa europaea L.

It is cosmopolitan althoug it is often forced by water-saturation of the soil to stay rather in places of higher situation. Its casts can often be seen on the dam-side and even in the inundation areas.

(3) *Soricidae*

The most generally occurring shrew species in the area is Sorex araneus, the only representative of shrews with red teeth, collected by me. It is worth mentioning that Sorex, resp. another member of the Neomys genus does not have any part among the data of GY. CSIZMAZIA from 1964, either. (It may be supposed that Sorex minutus is rarer in the flood plains of the Upper Tisza Region than, e.g., in the Tisza reaches at Szeged and its environs where I established its occurrence in a ratio of about 5.3:1 as compared with Sorex araneus (SZITTA 1974). I have succeeded in demonstrating *Sorex araneus* from collecting sites 2, 3, 5, 6, and 7.

Crocidura leucodon, a representative of Crociduridae, was found at collecting site 7. But I have not collected *Crocidura suaveolens* from the flood-plain, in the course either of my investigations at the environs of Szeged or of those at Tiszakarád (SZITTA 1974). I consider its occurrence only outside the dam, in drier biotopes, as

probable. The species are mentioned by I. VÁSÁRHELYI, in his unpublished paper, from Tiszakarád, as well, regarding it as frequent as *C. leucodon*. But he does tno designate the more exact place of its occurrence.

(4) *Microtidae*

Arvicola terrestris L.

In the neighbourhood of agricultural areas it is common. I have collected it in very low individual numbers, and observed at my investigations in the vicinity of Szeged, as well, how thinly this species, appearing elsewhere in large numbers, is present in the flood-plain. It is generally known that the gradation of the field-vole shows a certain periodicity. It is probable, therefore, that my investigations may have fallen between so-called periods "rich-in-voles". (They were collected by Csizmazia, in the course of his collectings in 1964, in approximately 38 individuals in ten days).

Microcrotus agrestis L.

It is known from this area on the basis of CSIZMAZIA's investigations (22 July, 1 August, 1964).

Ondatra zibethica L.

It occurs mainly at the sides of channels, crossing the flood-plain, resp. along the Tiszakarád Main Channel (Colecting site 7), as well as in the vicinity of the dead-arms, in not high individual numbers. The cause of this is probably the missing of a continuous *Phragmites,* resp. *Carex* vegetation. In the menu of ondatra shell-fishes often appear. I often found their remains e.g. at collecting site 7.

(5) *Muridae*

Apodemus agrarius L.

It is the most common Mammalia species of the investigated area. It is generally wide-spread in the Upper Tisza Region (SCHMIDT 1975, SCHMIDT 1969, VÁSÁRHELYI 1942). It is characteristic of its individual number that, from among the total collected small mammals, 65 percent was *Apodemus agrarius*. In the course of my collectings, it occurred in every biotope and proved to be dominant. We know but little of the ecological demands of this animal, known from not every region of our country, as yet. The opinions vary in respect of the criteria of its occurrence. It is a fact that in the course of my collectings, performed in different regions of the country, I could not find it, as yet, in an expressly dry environment. A humid, hazy milieu must, therefore belong to the essentials of its life. This only factor is, however, by no means satisfying for acknowledging the conditions of its environment because areas of a microclimate, like this, can be found within any geographical unit. It probably prefers the rainy areas with comparatively little sunshine. It may be explained by this that this species is missing, for instance, from my collections in the environs of Szeged. They move in the day-time, too, particularly the young individuals. They are less cautious than, for instance, the other members of the *Apodemus* genus. They move in rainy days. too. Their food is mostly of animal origin. I have observed on my animals held in captivity, as well, that they prefer this form of nourishment.

Micromys minutus PALL.

I have trapped two individuals of these in their typical habitats, Collecting site 7.

Apodemus sylvaticus L. & *A. flavicollis* MELCH.

I have found a typical flavicollis at Collecting site 4 (e.g. no. 415). The commones ones were, however, on the basis of their external features, the forms to be considered

as transitional (e.g. no. 340) where the correlation of tail-length and body-length and the sharp colour effect referred to flavicollis, on the other hand, the lack of the yellow hackles hints to sylvaticus. I have, otherwise, observed this in the course of my investigations at Szeged, as well.

It is the most commonly occurring mammal, apart from *Apodemus agrarius,* and like this, it may be evaluated as subdominant. It is to be mentioned that in the Tisza Region at Szeged I have found it dominant.

The features of the *Apodemus flavicollis* species are characteristic only in adult age. It is for this that I have dealt with both species jointly.

Rattus norvegicus BERK.

It is very frequent mainly in the neighbourhood of waters (dead-arns, „living" river-bed, channels). Of this we may be convinced on the basis of many traces. I have trapped an individual close to Collecting site 7.

Mus musculus spicilegus L.

It is a constant and, in addition to *Apodemus sylvaticus,* subdominant member of the associations of the region. I consider this as interesting because in the course of my collecting, performed in other natural habitats, the representatives of the Mus genus could only be found rarely. Thus on the confines of Szeged, as well. I have only collected them in large numbers in areas exposed to anthropogenous influences.

Carnivora

Vulpes vulpes L.

It can be regarded as frequent. I have more then once observed its trails and the traces of its activity.

Mustela erminea L.

Its data referring hereto play a part in the enumeration of I. VÁSÁRHELYI.

Mustela nivalis L.

It can mainly occur in drier parts of the flood-plain (environment of agricultural areas). I have collected a female individual from collecting side 4 and have often observed its trails, for instance, in collecting side 7, as well. On 15 November 1974, I have obtained a litter of young male individuals (4 of them) from the confines of the village.

Mustela putorius L.

An individual shot in the region is mentioned by CSIZMAZIA on 29 July 1964. On the basis of informations got from the regional population, it may be comparatively common.

Ungulata

Capreolus capreolus L.

I have often met its smaller packs in the flood-plain and outside that.

Results

As from the period of my investigations (autumn — winter period) — as far as I know — there were no mammalogical data available from the Upper Tisza Region, I may have succeeded in contributing with these to the completion of the mammalogical picture of the indicated area.

Comparing the results of my collections with the data of others, we can ascertain the presence of about twenty species of mammals in the neighbourhood of Tiszakarád.

It can be established that the fauna of the Tisza Upper Region is a little different from the faunal picture of the Southern Tisza Region both in quantitative and in qualitative respects. The former one is characterized by the dominance of *Apodemus agrarius*, followed by *Apodemus sylvaticus — Apodemus flavicollis* and *Mus musculus spicilegus, Sorex aranens,* while the latter area is characterized by the dominance of *Apodemus sylvaticus — Apodemus flavicollis* and the subdominance of *Sorex araneus.*

We have succeeded in getting recent data converning the ecological demands of the single mammalian species by means of trapping in the different habitats. These establishments refer exclusively to the biocoenosis of the flood-plain along the river o which the cast-analysing investigations cannot be applied.

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Adatok Tiszakarád környékének kisemlős faunájához

SZITTA T.

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Kivonat

Szerző 1974. szeptember—december közötti Tiszakarád környékén végzett emlőstani vizsgálatai eredményeit közli.

Az itteni csapdázások során nyert adatokat összevetve Szeged-környéki eredményivel rámurat a folyó felső és alsó szakaszának némiképp különböző emlősfaunájára. A Felső-Tisza-vidéken az *Apodemus agrarius,* a déli Tisza-szakaszon az *Apodemus sylvaticus* dominanciáját állapítja meg.

A dolgozat tartalmazza a különböző élőhelyeken végzett vizsgálatok során tett ökológiai jellegű megfigyeléseit is.

Prilog poznavanju faune sitnih sisara u okolini Tiszakarád

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Abstract

Autor prikazuje rezultate istraživanja sisara u periodu sept.-dec. 1974. god. u okolini Tiszakarád. Uporedjujući dobijene podatke sa navedenog područja sa rezultatima istraživanja iz okoline Szeged, ukazuje se na izvesne razlike faune sisara na gornjem i donjem toku reke. Utvrdjeno je da na gornjem području Tise dominira *Apodemus agrarius*, a na južnoj deonici *Apodemus sylvaticus*.

U radu su prikazana i posmatranja sa različitih biotopa, koja imaju ekološki karakter.

Данные относительно фауны мелких млекопитающих района Тисакарад

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Резюме

Автор публикует результаты исследований, проведенных в сентябре-декабре 1974 г. в районе Тисакарад. Сопоставляя данные, полученные здесь при ловле с помошью капканов, с результатами в районе г. Сегед, автор указывает на некоторые различия фауны млекопитающих верхнего и нижнего течения Тисы.

В верхних притасайских районах доминирует *Apodemus agrarius*, в южных — *Apodemus sylvaticus*.

Работа содержит наблюдения экологического характера, сделанные в ходе проведенных в различных местах мест онахождения животных исследований.

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NUTRITION-BIOLOGICAL INVESTIGATION INTO THE RED FOX POPULATION LIVING IN THE FLOOD PLAIN OF THE TISZA—MAROS

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(Received 6 May 1978)

Abstract

I am summarizing my investigations performed until now in the flood-plain of the rivers Tisza and Maros in connection with the nourishment-biology of the red fox, as follows:

The relative proportion and frequency of the single kinds of prey in the gastric contents is changing. It depends upon the season and mainly upon the degree of inundations. In the stomachs, the prey participation in mammals, birds and carcasses is the largest, in respect both of total weight and relative content. The other vertebrates and invertebrata as well as plants, do not form any considerable proportion.

The rodents, occurring frequently in the investigated area, occur in the prey, too, more frequently. The rarer ones occur in the prey, to, more rarely. But from among the non-domesticated bird species, living in this area, only the pheasant may be found in the list of preys with great frequency. The other bird species, in however large number they live in the area, can be met with in the list only sporadically and with low frequency. This otherwise agrees with the results of the nourishment-biological investigations in the southern part of Hungary (Erdei, 1977).

After analyzing the problem of advantage and damage, it may be ascertained that its damaging is expressly of game-economical direction. 63 percent of the gastric content can be regarded as originating from a harmful activity, 26 percent is useful because of destroying harmful rodents, 11 percent of the gastric content is indifferent. Taking into consideration that in Winter the majority of the pheasant cases are cocks — sex can easily be established on the basis of feather from the pectoral region —, this cannot be considered as a pure damage because these are mostly wounded cocks.

Taking all things into consideration, I consider the fox as a useful constituent of the biocoenosis in the flood-plain. Apart from destroying harmful rodents, it also performs an important hygienic role which has remained exclusively its task. It replaces the role and activity of the birds of prey and fur-bearing predatory animals, exterminated or becoming less frequent in the meantime. So far this is possible at all under the changed conditions. (Cf. Graph 2).

The red fox is our most frequent home rapacious mammalian species. It has been hunted in this country from time immemorial because this sport was always liked by the Hungarian hunters. Fox-hunting is variegated, full of trick and stratagem. It is sniped or killed from stalking, with deceptive whistle, in driving, beaten off with dogs or dug out of its burrow, even today, it is often caught with different snares and traps. Of late, it is frequently destroyed with poison and gas. In spite of all these, it is the unique one of all the home fur-bearing beasts of prey which was able to accommodate itself to the changed natural-environmental conditions. The red fox takes, therefore, an outstanding place among the home mammalian rapacious species and thus deserves a particular attention.

This is the situation not only in Hungary but in several other States of Europe, as well. Some Western European scientists pay particular attention to the red fox. The high level of the fox-research there, the method with which the sphere of problems connected with the red fox and its single components are investigated, are generally known. PETZSCH (1966), as well as KOENAN (1952) also ponder over the points of view of usefulness and deleteriousness what is an important direction of investigation in this country, too. BEHRENDT intensively examines (1955) the composition of food and the percentage of the main constituents. SPITTLER (1972) analyzes the connections between the density of population, as well as rabies and the stock of small game. STUBBE (1974) also deals *in extenso* with population-biology, including the causes of mortality, as well. ENGLUND investigates (1965) in detail the composition of gastric content which changes, in his opinion, constantly and dynamically, depending upon place, season, period, the number of preys and red foxes, as well as upon several other factors.

Material and method of the investigation

The aim of my research work is: to obtain data of what the role of red fox is in the habitat most-approaching the sometime natural conditions, in the flood plain of the Tisza-Maros, in the order of biocoenosis. How the way of life, the radius of motion, and the density of population are influenced by inundations. In what its economic damage and use are realized.

The research area was the flood plain of the Tisza from Mártély to the mouth of the Maros, as well as the flood-plain of the Maros as far as the confines of the town Makó -together 7600 ha. This area consists in 50 percent of forests, in 35 percent of agricultural areas (mainly meadow, pasture, in a smaller proportion plough-land, orchard), in 15 percent of other areas (open water, flat bog-peats, reedy part). This area is a particular dash of colour in the more and more modernized aspect of the region. Its fundamentals in game economy are excellent.

The method of investigation contains the following:

(1) The analysis of the frequency of preys on the basis of gastric remains.
(2) Establishment of the relative content of the investigated stomachs.
(3) Calculation of the total gastrict content (biomass).
(3) Calculation of the total gastrict content (biomass).
(4) (Frequency of the occurrence of some preys, as compared with the number of stomachs.
(5) Species-list of prey animals, on the basis of gastric contents.
(6) The analysis of the frequency of some kinds of prey on the basis of some remains and excreta found on the ground.
(7) A list of prey animals on the basis of some remains and excreta found on the ground.

Results

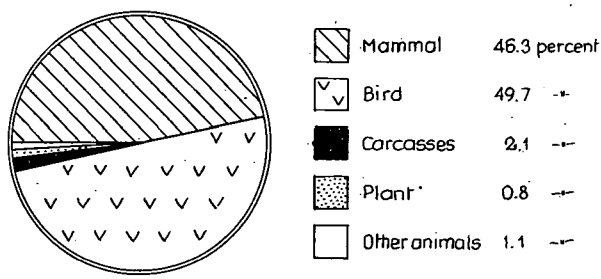
The different remains, findings found in the stomachs were divided into six groups: (1) mammals, (2) birds, (3) other vertebrates, (4) invertebrata, (5) carcasses and garbage, (6) plants. These are the main kinds of prey.

(1) I have ascertained on the basis of analysing frequency that, in the area investigated, the mammals occurred the most frequently (52.4 percent). These are followed by the invertebrata (23.1 percent) and birds (19.2 percent). The frequency of the other kinds of prey is insignificant. (Cf. Table 1).

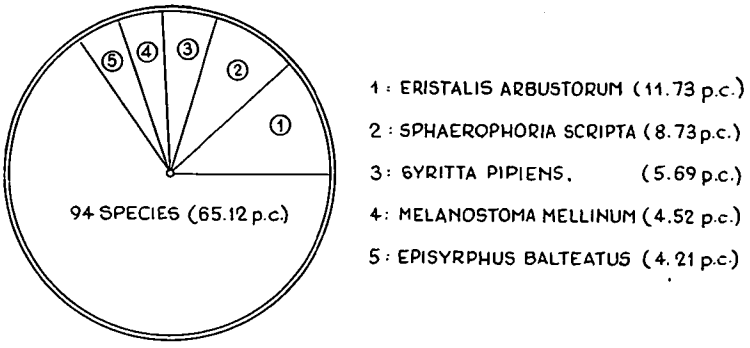
Table 1. *Analysis of the frequency of certain kinds of prey on the basis of the gastric contents (1974–1977)*

	Pieces of prey	Percentage of occurence
(1) *Mammals* (a+b+c)	109	52.4
(a) *brown hare*	11	5.2
(b) *small rodents*	92	44.3
mice	16	7.7
field-voles	73	35.1
sousliks	3	1.5
(c) *insectivores*	6	2.9
(2) *Birds*	40	19.2
useful wild-fowl	26	12.5
domestic fowl	1	0.5
other birds (+eggs)	13	6.2
(3) *Other Vertebrates*		
amphibia	1	0.5
(4) *Invertebrata*	48	23.1
molluscs	2	1.0
insects	46	22.1
(5) *Carcasses*	4	1.9
(6) *Plants*	6	2.8

(2) The relative gastric contents are generally in no correlation with frequency. The gastrict-content percentage of some main kinds of prey (i.e. their weight percent) considerably departs from the frequency percent. Thus the relative percentage of the main kinds of prey in the gastric content is the following: the percentage of the largest birds is 49.7, that of mammals is 46.3, that of the carcasses and garbage is 2.7, all the other relative percentages are insignificant, not more than 1.9 percent. (Cf. graph 1).



Graph 1. *Relative percentage of the main kinds of prey in the gastric contents Tisza-Maros flood plain (1974—1979)*



Graph 2. Advantage and disadvantage on the basis of the relative gastric contents Tisza–Maros flood-plain (1974–1977).

(3) After summarizing all gastric contents, I have got 10,522 g total gastrict content (biomass) in the area investigated, during the period of investigations. The weight of the average content, falling on a single stomach, was 148.2 g, it did not reach, therefore, 15 decagrammes.

(4) It is important to compare the frequency of the occurrence of the single kinds of prey with the number of stomachs because, in this way, it can concretely be established, in how many stomachs the single kinds of prey occur. And this is very interesting from the point of view of game economy, as well. 20 stomachs have for instance contained only mammals and in 11 of these there were only brown hares. Pheasants were found in 25 stomachs and in 21 of these, apart from pheasants, there was nothing else. From these I have concluded that the red fox, after stuffing itself with pheasant or hare, takes but rarely any other food.

(5) The species list of prey animals on the basis of the gastric contents is as follows:

Mammals	*Pieces*
(a) *brown hare (Lepus europaeus)*	11
(b) *small rodents*	
wood mouse and field mouse *(Apodemus sylvaticus, Mus spicolegus)*	12
harvest mouse *(Micromys minutus)*	3
brown rat *(Rattus norvegicus)*	1
field vole *(Microtus arvalis)*	54
subterraneous vole *(Pitimys subterraneus)*	16
water vole *(Arvicola terrestria)*	2
ondatra *(Ondatra zibethicus)*	1
souslik *(Citellus citellus)*	3
(c) *insectivores*	
forest shrew *(Sorex araneus)*	6
Birds	
pheasant *(Phasanius colchicus)*	25
mallard *(Anas plathyrhyncha)*	1
domestic fowl *(Gallus domestica)*	1
jay *(Garrulus glandarius)*	1
turtle-dove *(Streptopelia decaocto)*	1
turtle *(Turtur turtur)*	1

starling *(Sturnus vulgaris)*	1
black-headed gull *(Larus ridibundus)*	1
peewit *(Vanellus vanellus)*	1
common coot *(Fulica atra)*	1
non-determined species	1
eggs	5
Other Vertebrates	
frog (non-determined in detail)	3
Invertebrata	
snail (non-determined in detail)	2
common dung-beetle *(Geotrupes mutator)*	2
eastern maybeetle *(Anoxia orientalis)*	5
grashoppers *(Tettigonioidea)* (non-determined in detail)	31
non-determined insects	8
Carcasses	
deer *(Capreolus capreolus)*	1
non-determined species	3
Plants	
dewberry *(Rubus caesius)*	3
non-determined species	3

(6)–(7) The remains of food found in a stomach may be brought into connection with a certain date. In the vicinity of burrows some food-remains including a longer period can be found. It is a characteristic of bone, feather, chitin remains, hair and of various other things to be found in the excrements, too, that the remain, in contradistinction to the perishable part of remains (e.g. flesh), do remain for a comparatively long time. The remains found in the burrows, resp. on the ground, cannot replace the prey and species list prepared on the basis of exposing the stomach. But they complete research and may draw the attention to certain problems. The remains of small rodents (e.g. field-voles, mice, etc.) can less be found on the ground than those of the mammals of a larger body, resp. birds of a larger body. In the area investigated, there were found 63 bird remains, 10 brown hare, 4 sousliks and only 30 mouse- and vole-remains. (Cf. Table 2).

Table 2. *Analysis of the frequency of certain kinds of prey on the basis of prey remains found on the ground (1974–1977)*

	Pieces of prey	Percentage of occurrence
(1) *Mammals* (a+b+c)	48	29.1
(a) *brown hare*	10	6.1
(b) *small rodents*	34	20.6
mice	11	6.7
field-voles	19	11.5
sousliks	4	2.4
(c) *insectivores*	4	2.4
(2) *Birds*	63	38.2
useful wild-fowl	41	24.9
domestic fowl	4	2.4
other birds (+eggs)	18	10.9

(3) *Other vertebrates*		
fish	5	3.0
reptiles	1	0.6
(4) *Invertebrata*		
mollusks	3	1.8
insects	28	17.0
(5) *Carcasses and garbage*		
carcasses	3	1.8
garbage	6	3.7
(6) *Plants*	8	4.8

The number of red foxes can already be influenced only by the man today. That the red fox should not be overmultiplied it is in the interest not only of the man but of the fox, as well. In the area investigated, the number of populations is above the tolerable one. One individual falls to 0.2–0.3 piece/sq. km, i.e. 500–300 hectars. It survives the spring inundations, going quite simply to the protected side and transferring there the sphere of its movement. In this case, the density of population here increases. As a result of the more frequent movement and increased contact connected with mating (rutting) in the late Winter, resp. with raising the progeny, rabies manifests itself annually. The vehemence of this annually changes. Of late, the most rabies cases were observed this year (1978).

After the retirement of water red foxes return to the covered flood-plain, providing for a godd covert lair. On this occasion, in Spring, it is customary to drive back the number of foxes. The burrow is explored and one tries to destroy the suckler (vixen) together with the youngs. One of the ways of decreasing the number of red foxes is poisoning. But poisoned morsels and eggs make the least damage in the red fox itself. On the other hand, the protected and very rare birds of prey very often perish for these. Gassing is much more effective than this and is already generally used. But as a practising sports-hunter and a biologist, I do not approve of this method.

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Tisza—Maros hullámterében élő rókapopulációk táplálkozásbiológiai vizsgálata

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Kivonat

A Tisza—Maros folyók hullámterében a róka táplálkozásbiológiájával kapcsolatos eddigi vizsgálataimat a következőkben foglalom össze.

Egyes zsákmányféleségek relatív aránya és gyakorisága a gyomortartalmakban változó. Az évszaktól és főleg az elöntések mértékétől függ. A gyomrokban mind az összsúlyt, mind a relatív tartalmat illetően az emlős, madár és dög zsákmány-részesedés a legnagyobb. Egyéb gerinces és gerinctelen állatok, valamint a növények nem képeznek jelentős részarányt.

A vizsgálati területen előforduló gyakori rágcsálók a zsákmányban is gyakrabban fordulnak elő, a ritkábbak pedig a zsákmányban is ritkábban. De az itt vadon élő madárfajok közül zsákmánylistán csak a fácán található nagy gyakorisággal. A többi madárfaj, bármilyen nagy létszámban is éljen a területen, csak kis gyakorisággal vagy elvétve fordul elő. Ez egyébként megegyezik a dél-magyarországi táplálkozásbiológiai vizsgálatok eredményeivel ERDEI (1977).

A haszon és kár kérdését elemezve, megállapítható, hogy károkozása kifejezetten vadgazdálkodási irányú. Káros tevékenységéből eredőnek tekinthető a gyomortartalom 63%-a, hasznosnak a káros rágcslálók pusztítása miatt 26%, közömbös gyomortartalom 11%. Ha figyelembe vesszük, hogy télen a fácánesetek többsége kakas — a melltájéki tollak alapján könnyen meg lehet állapítani a nemet —, akkor ez nem tekinthető tiszta kárnak, ugyanis ezek leginkább sebzett kakasok.

Istraživanja biologije ishrane populacija lisice na plavnom području Tisza—Maros

M. ERDEI
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Abstract

U radu su prikazani rezultati dosadašnjih ispitivanja biologije ishrane lisice na plavnom području reka Tisza—Maros. Na osnovu analize želudačnog sadržaja utvrdjena je relativna razlika u kvalitetu i čestoći učešća plena u ishrani. Kako kvantitet tako i relativni sadržaj plena u želucu je predstavljen učešćem sisara, ptica i strvine. Ostali kičmenjaci, beskičmenjaci kao i hrana biljnog porekla ne predstavljaju značajnu komponentu.

Učešće pojedinih vrsta glodara u ishrani lisice je u pravoj srazmeri sa njihovom brojnošću. Od ptica se najčešće javlja fazan, dok je učešće u ishrani ostalih predstavnika ornitofaune istraživanog područja, čak i pored visoke brojnosti minimalan ili sporadičan. Ovi podaci se poklapaju sa rezultatima istraživanja biologije ishrane lisice iz južne Madjarske, ERDEI (1977).

Analizirajući korisnost i štetnost, može se konstatovati da se lisica javlja kao lovoprivredna štetočina. Želudačni sadržaj u 63% ukazuje na njenu štetnost. U 26% njena korisnost se ispoljava tamanjenjem štetnih glodara, dok su želuci sa neutralnim sadržajem zastrupljeni u 11%. Štetnosat lisice se umanjuje ako polazimo od činjenice da u zimskom periodu u njenoj ishrani u odnosu na fazane uglavnom učestvuju ranjeni petlovi.

Исследование биологии питания популяций лисицы, живущих в пойме р. Тиса-Марош

М. Эрдеи

Комиссия по исследованию Тисы, Сегед

Резюме

Проведенные нами исследования относительно биологии питания лисицы в пойме рек Тиса-Марош можно подытожить следующим образом.

Анализ содержания желудка показывает, что соотношение отдельных видов добычи и частота изменяются в зависимости от времени года и, главным образом, от размера затопления. Как по общему весу, так и по относительному содержанию большую долю составляют млекопитающие, птицы и падаль. Прочие по звончные и беспозвоночные животные представлены в оче ньнезначительном количестве.

Чаще встречаются в качестве добычи такие грызуны, которые являются более распространёнными на исследуемой территории, менее редкие, соответственно, и как добыча реже. Что касается живущих здесь птиц(диких), в списке добычи часто встречается лишь фазан. Остальные виды птиц, в каком бы большом количестве они здесь не встречались, лишь очень редко попадают в добычу. Это соответствует полученным ранее результатам относительно биологии питания лисиц в южной части страны (Эрдеи, 1977).

Анализируя вопрос о пользе и причиняемом вреде, можно установить, что вред имеет исключительно направление — против охотничества. К вредной деятельности можно отнести 63% содержимого желудка, к полезной деятельности — уничтожение вредных грызунов — 26%, к безразличной — 11%. Если принять во внимание, что зимой фазан, обнаруживаемый в желудке лисицы, чаще всего фазан-петух, что нетрудно обнаружить по перьям груди, это нельзя считать чистым вредом, так как это в основном раненые петухи.

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WORK-CONFERENCE ON EVALUATING THE WORK ON THE AREA OF THE KISKÖRE RESERVOIR AND ITS ENVIRONMENT

On 15 and 16 September 1978 a work-conference took place, as arranged by the Tisza-Research Working Committee and the Water Administration of the Middle Tisza Region.

On the conference there were represented, apart from the members of the Tisza-Research Working Committee, several national special institutions, thus: National Agency for Environment and Nature Conservation, the Hatchery and Research Institute for Pisciculture in Szarvas, the Water Administration of the Middle Tisza Region, the Water Administration of the Lower Tisza Region, the Hungarian Danube Research Station, the Scientific Research Institute for Managing Water-Supplies, the National Undertaking for Water Conservancy Investments, the Executive Committee of the Middle Tisza Region, the Middle Tisza Region Conservation District, and the Water Works of Debrecen. The research workers of the Jugoslav Tisza reaches were represented by professors of the University in Novi Sad.

The Conference began on 15 September, at 10.30 o'clock.

After the opening speech of the chairman, Dr. IMRE HORVÁTH, the researchers of the Tisza-Research Working Committee, working in the laboratory of the Tisza II River Barrage rendered accounts, resp. delivered lectures for introducing the discussion:

Dr. I. BANCSI: Results of researches performed in the Kisköre Reservoir and its environs.

P. VÉGVÁRI: Practical application of the results of investigations.

Dr. J. HAMAR: Practical and investigational tasks in connection with the future of the Reservoir.

The lectures were followed by a vivid debate. From the several persons taking part we are mentioning first of all the contributions of dr. JÓZSEF ÁRVAI (Nature Conservation), dr. J. OLÁH (Pisciculture, Szarvas), dr. K. KISS (Water Works, Debrecen), dr. M. MIKES (University, Novi Sad).

As a result of the debate, *the practical and research tasks connected with the future of the Kisköre Reservoir were accepted by the Conference.* These are as follows:

In the course of work, there are to be taken into consideration that:

(1) the present situation is a transitional state and from the former inundation

area, through the present-day shallow, marshy reservoir, a more uniform water surface of greater depth will take shape,

(2) by the concrete interventions there are equally touched the interests of water management, nature conservation, environment conservancy and recreation,

(3) the Kisköre Reservoir is a part of the ecologically uniform, regional nature conservation system, not fully elaborated, as yet.

The subjects of research that are important for practice, as well, shall come to the front. These are dealing with getting acquainted with the environmental conditions of the reservoir, its effect on the human and natural environment, the tendency of changes, and with indicating the directions of the necessary interventions.

Accordingly, it is important to investigate the following problems:

effect of the instability of watercourses and water-surface,
importance of the isolation of water-spaces,
effect of the land vegetation remaining in the reservoir,
investigation of silting up, role of the deposit,
study of the marshy and hair-weed vegetation,
clearing up of polluting sources, enrichment in nutritive material and its consequences,
meteorological investigations,
invasion of the water fauna,
hygienic examination of the reservoir,
seasonal and diurnal instability,
effect of storing on the reaches of the river below the river barrage,
it is also necessary to study birds as indicators.

It is important to carry out regular flights and carry out aerophotographs for registering the changes taking place in the reservoir.

We shall reach that "water-governing" takes place by taking jointly into consideration quantitative and qualitative water regulations.

It would be useful to issue publications in Hungarian language, too, as a supplement of the periodical "Tiscia" on the Tisza-research, summarizing in different fields the results of Tisza research until now.

It is desirable that all the institutions and agencies, dealing in any form officially with the Tisza and the Reservoir, perform systematical and concerted actions.

Chairman is giving notice of that from that day the international research work concerning the Tisza was begun. The Tisza-Research Working Committee has prepared, together with Prof. Dr. VLASTA PUJIN, Head of the Institut za Biologiju, Novi Sad, and Prof. Dr. M. MIKES, both being present, the common plan of research on the lower Tisza region and the contract of co-operation, after that the universities had authorized working co-operatively.

The Conference was closed by the summarizing concluding words of I. Nagy, co-chairman of the work-conference.

In the afternoon, GY. RÉCSEY (Water Administration of the Middle Tisza Region) reported on the Tisza II River Barrage in a lecture with colour slides and subsequently with guidance on the spot.

In the evening, I. LŐRINCZ (Middle Tisza Region Conservation District) gave an illustration with colour slides of the nature conservation values of the Middle Tisza.

On 16 September, the participants of the Conference made a tour in the Reservoir on board the ship „Kisköre", discussing forthwith again the tasks of the future.

MUNKAÉRTEKEZLET A KISKÖREI VÍZTÁROLÓ TERÜLETÉN ÉS KÖRNYÉKÉN FOLYÓ MUNKA ÉRTÉKELÉSÉRE

A Tiszakutató Munkacsoport és a Középtiszavidéki Vízügyi Igazgatóság rendezésében 1978. szeptember 15-én és 16-án munkaértekezlet zajlott le Kiskörén.

Az értkezleten a Tiszakutató Munkacsoport tagjain kívül számos országos szakintézmény képviseltette magát. Így az Országos Környezet- és Természetvédelmi Hivatal, a Szarvasi Halászati Kutató Intézet, a Középtiszavidéki Vízügyi Igazgatóság, az Alsótiszavidéki Vízügyi Igazgatóság, a Magyar Dunakutató Állomás, a Vízgazdálkodási Tudományos Kutató Intézet, az Országos Vízügyi Beruházási Vállalat, a Középtiszavidéki Intéző Bizottság, a Közép-tiszai Tájvédelmi Körzet, a Debreceni Vízmű. A jugoszláviai Tisza szakasz kutatóit az Újvidéki Egyetem professzorai képviselték.

Az értekezlet szeptember 15-én 10.30 órakor kezdődött.

Dr. HORVÁTH IMRE elnök megnyitó szavai után a Tiszakutató Munkacsoportnak a Tisza II. Vízlépcső laboratóriumában dolgozó munkatársai tartottak beszámoló, illetőleg vitaindító előadásokat:

Dr. BANCSI ISTVÁN: A kiskörei tárolóban és környékén végzett eddigi kutatások eredményei.

VÉGVÁRI PÉTER: A vizsgálati eredmények gyakorlati alkalmazása.

HAMAR JÓZSEF: A tároló jövőjével kapcsolatos gyakorlati és kutatási feladatok.

Az előadásokat élénk vita követte. A számos hozzászóló közül kiemeljük dr. ÁRVAI JÓZSEF (OKTH), dr. OLÁH JÁNOS (HAKI), dr. KISS KEVE (Debreceni Vízmű), dr. MIKES MIHÁLY (Újvidéki Egyetem) felszólalását.

A vita eredményeként az értekezlet elfogadta a *Kiskörei Tároló jövőjével kapcsolatos gyakorlati és kutatási feladatokat:*

A munka során figyelembe kell venni, hogy

1. a jelenlegi helyzet átmeneti állapot és a volt hullámtéri területből a mostani sekély, mocsarasodó tárolón át egy nagyobb mélységű, egységesebb vízfelület alakul majd ki,
2. a konkrét beavatkozások vízgazdálkodási, természetvédelmi, környezetvédelmi és üdülési érdekeket egyaránt érintenek,
3. a Kiskörei Tároló része az ökológiailag egységes, ma még ki nem munkált regionális környezetvédelmi rendszernek.

Előtérbe kell kerülni a gyakorlat számára is fontos kutatási témáknak, amelyek foglalkoznak a tároló környezettani viszonyainak megismerésével, az emberi és természeti környezetre való hatásával, a változások tendenciájával és a szükséges beavatkozások irányának a megjelölésével.

Ennek megfelelően lényeges az alábbiak vizsgálata:

vízjárások és vízszint ingadozás hatása,
vízterek izolációjának jelentősége,
a tárolóban maradt szárazföldi növényzet hatása,
a feliszapolódás vizsgálata, az üledék szerepe,
a mocsári- és hínárvegetáció tanulmányozása,
szennyező források felderítése, a tápanyagdúsulás és következményei,
meteorológiai vizsgálatok,
a vízi fauna betelepedése,
a tároló higiénés vizsgálata,
évszakos és napszakos ingadozások,

a tárolás hatása a folyó vízlépcső alatti szakaszára,

a madarak, mint indikátorok tanulmányozása is szükséges.

A rendszeres repülések és légi felvételek készítése igen fontos a tárolóban bekövetkezett változások regisztrálásához.

El kell érni, hogy a "vízkormányzás" a víz mennyiségi és minőségi szabályozásának együttes figyelembevételével történjék.

Hasznosak lennének a Tiszakutatás „Tiscia" című periodikája szuplementjeként megjelenő magyar nyelvű kiadványok, amelyek különböző tárgykörben foglalnák össze a Tisza eddigi kutatásának eredményeit.

Kívánatos a rendszeres és összehangolt munka mindazon intézmények részéről, amelyek valamilyen formában hivatalból is foglalkoznak a Tiszával és a tárolóval.

Elnök bejelenti, hogy a mai nappal megindul a Tisza nemzetközi kutatása. A Tiszakutató Bizottság elkészítette az Institut za Biologiju, Novi Sad jelen levő vezetőjével, dr. PUJIN VLASTA professzorral és dr. MIKES MIHÁLY professzorral a Tisza alsó szakasza közös kutatási tervét és az együttműködési szerződést, miután a szegedi és újvidéki egyetemek a kooperációs munkát engedélyezték.

Az ülés NAGY ILLÉSNEK, a munkaértekezlet társelnökének összefoglaló záró-szavaival ért véget.

Délután RÉCSEY GYULA (KÖTIVIZIG) színes diákkal kísért előadásban ismertette a Tisza II. Vízlépcsőt, majd vezetést tartott a helyszínen.

Este LŐRINCZ ISTVÁN (Középtiszavidéki Tájvédelmi Körzet) színes vetítéssel mutatta be a Közép-Tisza természetvédelmi értékeit.

Szeptember 16-án az értekezlet résztvevői a „Kisköre" hajóval járták be a víztárolót és a helyszínen is megvitatták a jövő feladatait.

Dr. MARIÁN MIKLÓS

Tiscia (Szeged) Vol. XIV, pp. 229—238 (1979)

FROM THE LIFE OF THE TISZA-RESEARCH WORKING COMMITTEE TISZA-RESEARCH CONFERENCE X (1979)

Compiled by

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The latest session of the annual Tisza-Research Conference took place this year at the Centre of the Committee of the Hungarian Academy of Sciences, between 21 and 22 April, 1979. Besides the members of the Working Committee, several guests, researchers in the fields covered by the lectures, attended the lectures and took active part in the discussion.

In the meantime the Tisza-research has gained an international character by the fact that researchers coming, on the one hand, from the University in Novi Sad, and on the other from the State University in Užhorod (Ungvár), in the Transcarpathian territory of the Soviet Union have joined in the work; on the Yugoslav part Head of Department Prof. Dr. MELANIJA OBRADOVIĆ, on the Soviet part Head of Department Prof. Dr. I. FODOR attended the Conference.

The Conference was opened by the inaugural address of the president, † Prof. Dr. I. HORVÁTH, Head of the Department of Botany in the Attila József University:

Ladies and Gentlemen,

By way of introduction, let me greet the heads of departments of foreign sister universities, who have taken part in our joint research work and are now being present among us, as well as B. SIMÁDI, Director of the Water Conservancy, of the Lower-Tisza Region ZSUZSA DVIHALI and Mrs. A. BALÁZSFALVI, ex officio members of our conference and Prof. Dr. GY. BERENCSI, University Medical School, Szeged, as guests.

Our Conference is confronted with the task of listening to the reports on the results of last year's research work and of discussing the problems involved. As you may see from the items on the agenda printed on the invitation card, the first subject will cover the investigations conducted in the region of the Tisza river barrages; the following subject will be a report on the investigations carried out in Tisza reaches and nature reserves outside the Kisköre river barrage region.

The next speaker was Prof. Dr. MELANIJA OBRADOVIĆ; she greeted those present. She expounded the particular aspects of the Tisza research where she thought cooperation between the researchers of the University of Novi Sad and the Tisza-Research Working Committee possible. She thought it desirable that, in future, as close connections as possible should be developed between their team and the Tisza-Research

Working Committee, suggesting that an exchange of researchers should be organized for the implementation of this project.

Prof. Dr. I. FODOR greeted those present at the Conference in the name of the Biological Departments of the University in Užhorod. He deems it a pleasure — he said — that the results of their Tisza research can be contributed to the Tiscia. As far as they are concerned, they do their best to ensure an undisturbed co-operation. He wished the lecturers and those present at the Conference successful and fruitful work.

Dr. B. SIMÁDY gave an account of the great flood in 1879 and of its implications. In his lecture, he acquainted the audience with what the Tisza floodwaves were like before the river had been controlled, then he talked about the floodwave formation by the river in the last century. He analyzed in detail the situation during the peak flow in 1970 and its impact, forecasted the flood conditions to be expected in future, the possible dangers and the guarantees of how to prevent these dangers.

Dr. M. MARIÁN gave concise information on the results of the Tisza-research in 1978.

The Working Committee operated in 1978 — year 21 of the Tisza research — under the auspices of the Hungarian Academy of Sciences on the subject "A complex research of the flood-plain of the Tisza, with special regard to the river barrages and the nature reserves".

The centre of the investigations was the Lower-Tisza Region and the area of the Kisköre River Barrage. In addition to these areas, investigations continued along the full stretch of the River Tisza in Hungary, and a new test area was marked out in the Upper-Tisza Region.

On the results of the research reports are given by the lectures of Tisza-Research Conference X of 1979. Here only the most important events of the year 1978, some characteristic data of the research are mentioned.

In May, the two-day Tisza-Research Conference IX, held in Szeged, where several institutions had representatives was closed with good results. 28 lectures in all were delivered by approximately two-thirds of the members of our Working Committee. About 50 researchers took part in the discussion.

Several research fellows of our Committee and of the institutions involved attended the Tisza-Research Working Conference organized by the Water Conservancy of the Middle-Tisza Region at Kisköre, in September. At this conference, the results of research relevant to this district and future tasks were discussed, with special reference to practical considerations.

The Tisza-Research Working Committee, the State University in Novi Sad and the State University in Užhorod came to an agreement to co-operate. In this way, an investigation into the life of the River Tisza can be carried out on an international basis, all along the river.

Vol. XIII of the journal Tiscia and supplement 1 were published.

The Tisza-research was made by 53 researchers, the work being voluntary and unpaid; the distribution of the subjects were: water chemistry 2, physical geography 1, hydrobiology 14, botany 10, zoology 26. In the course of the year five additional research fellows joined our programme. Our results were published in 43 papers, contributed to the journal Tiscia and to other scientific publications. 46 lectures were delivered on the subject of our researches by the members of our Working Committee at various scientific meetings. Seven of our researchers went on study-tours in Hungary, and one abroad. Three of our researchers took their doctor's degree at the university during the year.

The outposts (buildings) at Körtvélyes and Tőserdő, the mesoclimate measuring stations at Körtvélyes, Sarud and Tiszaszöllős, the light-trap at Körtvélyes have functioned well. Our small ship "Kolokán" served our voyages well.

Our researchers can find in our library including hundreds of volumes not only biological works and publications on nature conservation and environment protection, but also data of a climatological character collected by our meteorological observation posts and datum series relevant to the chemistry and quality of the water in the Lower-Tisza Region (going back to several years past).

The most typical characteristic of the climatic conditions in the area is a natural tendency of the climate to turn warm, arid and hot in summer, when this tendency is manifested by the temperature avarages as well as by the frequent high rises in temperature. In the Southern Tisza valley, at Körtvélyes, our meteorological observation post has functioned for more than half a decade. The datum series based on our observations allow us to evaluate the deviations in terms of the experiments carried out in the river bed and in the flood-plain and inundation areas.

The river and the surface formations of the flood-plains covered with varying vegetation have somewhat differing microclimatic temperature conditions. In the flood-plains, the influence of the climate characteristic of the closed forest associations does not allow the microclimate characteristic of the Tisza valley system to have its influence felt beyond strict limits. The mass of water in the river, with its peculiar climatic influence, is similarly supposed to be a limiting substratum bringing certain characteristics into relief.

In summer, in clear, windless weather, the interplay between the substrata of the Tisza valley (heat- and humidity-circulation) system can be strongly felt. By this interplay a lowland, flood-plain microclimate (that of the inundation area) is formed. Besides, this interplay creates a macroclimate which, in its outer manifestations, differs from the climate of the surrounding lowland areas.

Thereafter, the lecturing began.

Investigations conducted in the district of the Tisza river barrages

(1) ANDÓ, M.:
Investigations conducted in the district of the Tisza river barrages

Contributions to the discussion:

MARIÁN, M.: Does the high vapour content of the flood-plain originate in an evaporation sent forth by the meadow plants or has it some other cause?
Answer: The conditions of humidity are governed by the influence of the forest. In the flood-plain, the temperature of the air will fall if the grass is high, and will rise, if the grass is close to the ground.

GALLÉ, L., Sr.: (Completion) In the forest at Adorján we have found lichens of large thalli wich generally do not live outside forests covering high mountains. We found the lichens in each case growing on that side of the tree-trunk which faced the river Tisza. By this, it is proved that humidity, coming from the Tisza, undoubtadly took part in their settling down. He met a similar case in Tiszafüred: mountainous lichens lived similarly on the side of stones from the Tisza. The mentioned cases also indicate the accomodation to the microclimatic conditions.
Answer: The lecturer thanks for the completion.

BÁBA, K.: How much are the microclimatic conditions affected by the presence of forests in the flood plain?
Answer: The vapour content of the air is considerably affected, determined by forests. Further on he notes that the Tisza-monograph in which he gives an account on the climatic relations of the Tisza flood-plain, is being made.

(2) BANCSI, I. and P. VÉGVÁRI:

Importance of the research of the matter curent of the Tisza in the management of water-supplies

It is characteristic of the river water that therein "water bodies" of different qualities and sizes pass which — in respect of their chemical and biological character differ from one another. These manifold natural and artificial effects continually change, as the concomitants of the chemical and biological processes, taking place in them.

In the up-to-date water conservancy system of the Tisza valley, it is a basic requirement to make an effective use of the water supply of limited quantity. Of late decades, the acceleration of the social circulation of water makes urgent a more effective solution of the water quality regulation in the Tisza.

The lecture is dealing with the elements of the peculiarities — among them with the connection between water level, water output, water speed — which affect the quality of water. It also touches upon the regularities of the transport of the floated river deposit, the problems of the content and yield of mineral materials and the oxygen supply, as well as upon the possibilities of affecting these.

Contributions to the discussion:

BERENCSI, GY.: Did any case occur in which mercuric caustics could be demonstrated from water?

SIMÁDY, B.: In his opinion the water quality control on a large territory can only be solved satifyingly with international co-operation. In respect of the Tisza, the formation of a five-sided co-operation would be desirable. At any rate, everything is to be done for preventing the further deterioration of water quality. This cannot be solved with efforts in Hungary alone.

KISS, K.: In connection with the indication of "P", he would approve of indicating with "mg/l".

BALÁZSFALVI, Mrs. A.: She asks, what is meant by the expression "aim-state". — She would consider proper to draw into the work also the co-workers of the Kisköre already asa laboratory, who have already so far acquired great experiences, into the preliminary investigations preceding the planning of the Csongrád river barrage.

Answer: In respect of mercuric caustics, there are no metric data, as yet. — It is desirable to carry out the proper technological changes in order to ensure the least sewage damage. The imposition of fines because of causing pollution cannot assure any satisfying solution. Already in case of the Hungarian rivers of low yield, the estimation of the given aim-states should be begun.

(3) HAMAR, J.:

Differentiation of habitats in the Kisköre Reservoir

The five-year period of the damming of the river bed came to an end in 1978. The damming level was raised by about one and half m, thus the largest part of the area of reservoir got under water.

Depending upon the data of terrain and water movement, various habitats were formed from the marsh-land to the open water. In the shallow enough parts, the marsh and hair-weed vegetation grew up, meadows of large extent are formed by the filamentous algae; in the open water plankton organisms (e.g., Cyanobacteria) have a decisive role.

The quality of water is likewise characterized by the mosaic-like structure. The present-day situation confirms the earlier opinion of experts that the removal of the land-vegetation from the reservoir, the arrangement of the terrain and the assurance of the proper water depth are fundamental requirements of the protection of water quality.

Contributions to the discussion:

BERENCSI, GY.: What gnat density is observed in this area? What species composition may be esteblished?

MARIÁN, M.: Are the unfavourable hydrographical conditions effective in the river bed of the Tisza?

VÖLGYES, GY.: Could the algal masses be utilized for the aims of foraging?

BALÁZSFALVI, Mrs. A.: In the area of the community Poroszló, the nutritive material could be extracted with polyelectrolytical treatment.

HORVÁTH, I.: He raises the questions of applying the possibility of modelling.

Answer: Black flies (*Simulium* sp.) begin to appear. — The alluvial content of the Tisza is rather high, the microvegetation promotes siltation and, in addition, the development of the anaerobic processes. It may be established that in our area, siltation is one of the most dangerous processes. The free water motion is, namely, retarded by the plant mass that remained there after arranging the terrain of the reservoir. — Modelling of the area was tried but the results have not been satisfying, as yet.

(4) B. TÓTH, MÁRIA:

Bacteriological investigations in the Kisköre Reservoir

The water surface of the Kisköre Reservoir was raised in April, 1978, to National Level 89.00 m, corresponding to the second pace of building. In this way, more than one standingly water-covered area was induced in the area of the reservoir.

In the area of the Kisköre Reservoir, complex hydroecological investigations were carried out. The water bacteorological investigations formed a part of these. The selected and systematically investigated water surfaces were: the dammed up stretch of the Tisza, falling into the space of reservoir, the bay at Abádszalók, the meadow at Sarudi, the flat before Poroszló, as well as the brook Eger and the water course of the Tisza.

In the course of the investigation we followed with attention the count of bacteria and the formation of the quantity of these. By the raised water level a considerable quantitative change was induced in the bacterio-plankton of the water getting out in to the area of reservoir.

Contributions to the discussion:

BERENCSI, GY.: He asks if *Salmonella* species were found in the course of investigations. He calls the attention of the researchers of the Station of Public Hygiene and Epidemiology to Leptospirosis.

BALÁZSFALVI, Mrs. A.: She asks if they succeeded in cultivating the strain of *Clostridia.*

ESTÓK, B.: In the lower sector of the Kisköre Reservoir there are accordingly no *Salmonella,* at the same time, the Leptospira-induced diseases are known. The decrease in germinal count is lower owing to settling down but this sediment may be rich in anaerobic spore masses. Therefore, the sediments should be examined, as well.

HEGEDŰS, MÁRIA: She asks if a connection was found between the direct bacterial count and the number of cultivated germs.

Answer: Clostridium has not been cultivated. — Between the direct and cultivated germ counts hardly any difference could be found.

(5) BANCSI, I.:

Intensive investigations in the bay of the Kisköre Reservoir at Abádszalók

One of the ways to recognize the peculiarities of the water ecosystems is the elaboration of the data received in the course of intensive investigations. On the basis of investigations performed between 21 and 24 August, 1978, in three, physiognomically different places of the bay at Abádszalók (open water, fringe of reeds,

place full of hair-weed), for 72 hours, with a frequency of four, resp. eight hours, the occurring processes were followed. On the site in every eight hours the full chemical examinations, in every four hours the measuring of the components necessary for studying the oxygen and carbon dioxide were carried out.

There followed no considerable change in the quantity of the main anions and kations but the diurnal fluctuation of the carbonate and magnesium content could be observed. Some outward forms of the vegetable nutritive materials (PO_4-P, NH_4-N, NO_3-N) could be measured in diurnally different concentrations. For the interpretation of the diurnal changes in the oxygen — carbon dioxide flow and the different components, we have performed the bacteriological, algological and zooplancton examinations, too, at the beginning and end of the intensive investigations, at all the three places.

The diurnal change in oxygen, carbon dioxide and hydrocarbonate refers to the occurrence of processes of different intensity at the indicated three places of examination. In the surface water layer of the open water carbonate and at the same time, in the region close to the bottom, free carbon dioxide was to be found continuously. The comparatively weak diurnal fluctuation of the carbonate content referred to a strong planktonic activity, being nevertheless in state of equilibrium with its environment. The processes taking place in the fringe of reeds are considerably more vigorous than those in the open water: the carbonate content changes within wide limits; here and there it can be demonstrated from the water layer close to the bottom, as well. The most dynamical changes were registered in the hair-weed: in the surface water layer at night free carbon dioxide, in the daytime carbonate was measured, the concentration of the free carbone dioxide fluctuated between 0 and 6 mg/l and that of the carbonate content between 0 and 12 mg/l.

It is verified by the intensive investigations that a considerably larger role must be attributed to the diurnal convectional currents in the uniform distribution of the dissolved materials of shallow standing waters than it was until now.

Contributions to the discussion:

SZITÓ, A.: He asks if in the bay of the Tisza at Abádszalók H_2S formation can be observed. —
Answer: There was observed something like, only that not there but in other Tisza-reaches

ESTÓK, B.: He asks what is the cause of the strong Ph-fluctuation. —
Answer: This fluctuation is to be regarded as quite moderate.

DVIHALLY, ZSUZSA: She raised a question in connection with the proportion of the primary production and O-respiration. —
Answer: They are (by and large) the same.

(6) SZITÓ, A.:

Midge species (Chironomidae) of the Kisköre Reservoir in the in the year of filling up

The filling up of the reservoir began in April, 1978, and in the deeper parts, as e.g. in the bay at Abádszalók, there existed a standing water-covered biotope already for years. In 1978, samples were taken on five occasions (12 May, 20 June, 29 August, 23 September, 10 October). These were taken from the open water with a boat, and in places of shallow water cover without any boat the environments of Poroszló, Tiszafüred). The larvae living on the hair-weed vegetation were collected by singling.

On the basis of the obtained data, it was established that in the bay at Abádszalók, from among the species forming the endobenthos, *Chironomus plumosus* is dominant and a *Camtochironomus* species is subdominant. In the parts at Poroszló and Tiszafüred, a permanent, strong hydrogen sulphide formation was observed.

Here we have not found any mud-dwelling larvae. On the submergible vegetation we have found the mining and coat-dwelling *Cricotopus bicinctus, Cricotopus silvestris,* as well as other *Cricotopus* species, in every month and at all the sampling sites. From the area of the bay at Abádszalók, we have also systematically collected the larvae of the *Cryptochironomus* species which is predacious and generally feeds with Oligochaetae. It is obvious, however, that Oligochaetae were found in none of our samples.

Contributions to the discussion:

BALÁZSFALVI, Mrs. A.: She asks if the lecturer has dealt with ascertaining the number of swarming and if the swarm can be foretold. —
Answer: A number of their generations could be established: in the course of April-May, September-October swarmings of high individual number could be observed. In connection with prognostification, no up-to-date forecast could be given because the number of swarming is considerably affected by temperature and the length of daytime. — She asks, too, what number of them flew out, as compared with the whole nutritive-material chain. —
Answer: At the Balaton, this is generally given in calorie. Here the number which flew out was low, as compared with the whole nutritive-material chain.

VÉGVÁRI, P.: He asks if the Chyronomidae get back into the same systems after their taking flight. —
Answer: This has not been investigated, as yet. It would, anyway, be desirous to ascertain this, he thinks, if the place is proper.

HAMAR, J.: What states, aerobian or anaerobian conditions are reflected by that?
Answer: Primarily, the formation of H_2S may mean a danger.

BÁBA, K.: He asks, to what extent the restocking of Chironomida can be affected by the Tisza dead-arms.
Answer: The dead-arms support their stocking.

(7) VÉGVÁRI, P.:

Trophity of the standing and river waters

The survival and development of several conceptions depend upon, in what degree they can be applied in practice.

The concept of trophity was elaborated, as is well-known, for lakes, mainly deep lakes. It is proved by the practice of past years that the conclusions drawn from the results of the investigations into the deep sees are valid not in every case for the aquatic ecosystems of another type (rivers, shallow lakes, reservoirs, etc.).

In the interest of being able to evaluate the trophity of standing and flowing waters, we have regarded as necessary to elaborate a conception which will have a more general validity than the present ones. In the special literature, we have more than once met the idea that — in the interest of the evaluability of the nutritive material content and the primary organic-matter production of the aquatic system — we must differentiate between the "trophity state" and "type" of the aquatic ecosystem. As this opinion was also supported by our investigations into the Tisza and the Kisköre Reservoir, in our idea we have separated the definitions connected with the stockpile of the vegetable nutritive material of the aquatic ecosystem and with its change and flow (trophic=nutritional) from the category dealing with the functions of the photo-autotrophic living beings, the possibility, process and consequences of the primary organic-matter production (Gr. trophos=feeder, trophity=productivity). The lecture is treating the problems of the nutritive-matter flow of the aquatic ecosystem, as well as the role of water trophity in the nutritive-matter flow.

B) **Investigations performed in other Tisza reaches and nature conservation areas**

(8) BANCSI, I., HAMAR, J. and HEGEDŰS, MÁRIA:
On the hygienic water quality and water-qualification of surface waters

The system of the biological water-qualification was elaborated by FELFÖLDY (1974), in his book: "A biologiai vízminősítés" (Biological water-qualification), on the basis of the known four groups of characteristics.

In case of water-utilizations, demanding hygienic supervision, the examination of the hygienic state of our surface waters is not dispensable. At present, the investigated bacteriological parameters are suitable for "estimating first of all the faecal pollution on surface waters and thus the potential danger of the contaminations, spreading by means of water" (DEÁK, 1977, Módszertani útmutató = Methodological guide-book).

As it is known, the physical, chemical and biological properties of surface waters produce favourable conditions of living, not only for saprophytic but also for parasitic micro-organisms. In case of water qualifications, performed from hygienic point of view, apart from the four known biological parameters, the contamination of water is therefore also to be taken into consideration in any case.

The authors suggest, in case of water-utilizations demanding the hygienic qualification of the surface waters, to take into increased consideration the hygienic parameters.

They propose to introduce the concept of hygienity for the designation of this characteristic property-group.

This general concept, the hygienity of surface waters, may give information about the possibility of the human and veterinary utilization, as well.

A declaration:

Mrs. A. NAGY: The flood plain at Tiszabercel (780 ha) was declared, and the flatland at Szatmár bereg (56 000 ha) will in the near future also be declared a nature reserve.

Contributions to the discussion:

BERENCSI, GY.: He recommends to use only water of drinking-water qualification for vaporizing plants. An absolute co-operation is needed between the organs of hygieny and water-conservancy. It would be advisable, as well, to extend water-supervision to the investigation into trace elements, too, in the future.
Answer: The Station of Public Hygiene and Epidemics in County Csongrád is in close co-operation with the Water Conservancy of the Lower-Tisza Region; its water-chemical investigations are carried out by the Laboratory of this Conservancy.

GALLÉ, L., Sr.: May the water of the Maros be drunk at present? Leaving Szeged, after how long flowing will the Tisza be clear water?
Answer: The Maros is, unfortunately, no more of "drinking-water" quality. After leaving great cities, like Szeged, the process of natural purification is of slower and slower tempo. It takes place in a longer stretch than in the years before.

ESTÓK, B.: He emphasized the importance of drawing water conservancy and hygienic work nearer one another, to in order to make, in this way, both works more effective and manifold.
Answer: The lecturer thanks for the contribution with which he considerably agrees.

(9) VÁNCSA, A.:

Biological water-quality of the Tisza between Tokaj and Tiszafüred, on the basis of the investigations carried out in 1969–1978.

Of the about 1000 km length of the Tisza 600 km lie on the territory of Hungary. To the area of the Water Conservancy of the Northern Tisza Region, a Tisza stretch of about 100 km length belongs.

On the Tisza-stretch between Tokaj and Tiszafüred, on the basis of the results of the investigations performed in the period between 1969 and 1978, beyond the evaluation of the human (communal, industrial and agricultural) water-utilizations, there is a possibility for evaluating the property-groups of the biological water-quality (halobity, trophity, saprobity and toxicity) concerning a longer period, as well.

The characteristic values of the physical-chemical-biological properties of the Tisza (maximum, standard, minimum), compared in time and space, enable us to characterize:

(1) the changes taking place in the single sectors,
(2) the differences to be observed in the longitudinal sector,
(3) the effects of polluters in the area of the main tributaries (Bodrog, Sajó) and
(4) in the area of Leninváros, exerting changes in water-quality.

The reaches of the Tisza river bed between Tokaj and Tiszafüred practically form the background of the Kisköre Reservoir. The evaluation of the results of investigations carried out for ten years may, therefore, afford some data for giving an expert opinion on the biological water-quality of the Tisza. In addition to this, the present compilation may also furnish basic data of additional character for the comparative evaluation of the changes in water quality in the period before damming.

(10) Mrs. HORVÁTH MÁRIA MÉSZÁROS and Mrs. KISS IBOLYA BALOGH:

Effect of the irrigating water, loaded with chemicals, exerted on the grown plants

Our experiments were performed in order to utilize the river and channel waters as irrigating water. The effects of engine-oil pollution and salt content were examined. (In 1978, the water of the Lower Tisza Region comprised 10 mg/l engine-oil on two occasions).

We have worked both pre-emergently and postemergently with two kinds of engine-oil concentration, water of high salt content, and control.

Seeds of capsicum, bean, pumpkin, horse-bean *(Vicia faba)*, mustard, wheat and maize were caused to germinate at the pre-emergent treatment. At postemergent treatment the same plants were treated, 4–5 days old.

The germination of seeds was not checked by oil and salt. In growth and development some differences manifested themselves. Accumulation of dry matter, growth, ascorbic-acid content and enzyme activity were measured. At treating 4–5 days old seedlings postemergently, we could observe that growth and development of the plants were checked both by oil and salt. The plants became bastard and perished. The degree of damage and the occurence of perdition were designated by the indices of the examined metabolism, as well.

Contributions to the discussion:

MARIÁN, M.: What was the origin of the oil-pollution of samples. Was the oil administered or did it get into the samples from the surface of the Tisza water?

Answer: In the experiments, discussed in the lecture, engine-oil was used. But the water of the Tisza was used, as well.

KISS, I.: The water of the Kurca is polluted with herbicides. Some of our rivers, thus the Sajó, as well, are strongly polluted. It would be necessary to moderate the pollution with vigorous measures.

VÉGVÁRI, P.: As to the oil content, it is not all the same, from where the water sample originates, from the streamline or from the neighbourhood of the river-side. It is questionable, from which water layer the sample was taken. —

Answer: The oil was artificially carried into the water of the Tisza.

(11) SZABÓ, A.:

Changes in water quality in the Eastern Main Channel, 1973–1978. Zooplankton investigations.

The close following of the water quality of the Eastern Main Channel is first of all important from the point of view of the drinking-water supply of the town Debrecen.

It is shown by the investigations between 1973 and 1978, that the water quality of the Tisza exerts a great influence on the annual and seasonal changes in the water-quality of the Channel. According to the results (concerning primarily the summer small-water period), in the sector at the mouth of the river (in the area of Tiszavasvár) the species and individual counts are still high (6–10.000 ind. 100 l). After going in the direction of Balmazújváros, this decreases more and more (4–800 ind. 100 l). The zooplankton composition and the ratio of the participation of species also change along the course of the river. The plankton is above all dominated by Rotatoria; occasionally — like in July, 1975 and 1976 — by Cladocera (*Bosmina* sp., *Daphnia* sp.), resp. the number of Copepoda also increases (thus in August, 1976 and 1977).

The members of *Brachionus* sp., *Keratella* sp., as well as the *Bosmina longirostris* and *Daphnia* species may be considered as characteristic.

On the basis of the zooplankton, between 1973 and 1978, the water quality of the Eastern Main Channel manifested itself — apart from minor differences — as uniform (beta-mesosaprobic); although in the year 1978, due to the continuous floods (high floating-matter content, large KOI values), in this relation a certain deterioration could be experienced.

(12) GÁL, D.:

Zooplankton of the Tisza-reaches between Szolnok and Szeged

The character of the lower Tisza reaches and together with this the quality and quantity of the zooplankton developing in the Tisza will in future be considerably changed by the river barrages, built and planned in the lower Tisza reaches (Tiszabecs, Csongrád). I have investigated for a year, with monthly samplings (at 11 sites), the zooplankton of the Tisza-reaches between Szolnok and Szeged, as well as in the parts near the mouth of tributaries.

It may be established from the investigations that in the zooplankton generally the Rotatoria species dominate both in species and in individual numbers (about 55 percent of the total zooplankton). The Entomostraca species are forming 30 to 35 percent, the Protozoa about 10 percent of the zooplankton.

A considerable pollution can be observed in the reaches below Szolnok (a considerable amount of sewage water is already carried by the Zagyva, too) and in those below Szeged. Here the amount of the zooplankton strongly decreases. Primarily the number of the beta-mesosaprobic organisms sinks from 45 to 20–25 percent. On

the other hand, the number of the alpha-mesosaprobic organisms rises on about 55 percent.

From among the tributaries, the Zagyva pollutes the Tisza strongly, by carrying a considerable amount of sewage water. The zooplankton of the Körös considerably differs from that of the Tisza. It carries new species into the Tisza, a number of which survive there, too. The quantitative and qualitative composition of the zooplankton of the Maros differs from that of the Tisza only in minimum.

Contributions to the discussion:

HAMAR, J.: According to his experience, the two-peaked maximum of the zooplankton becomes blurred as a result of being stored. He asks, in what direction the pollution affects the quality of water. And how the zooplankton, qualified on the basis of the saprobic system, will modify as a result of being stored. He asks, too, whether the Maros exerts no stronger effect on the zooplankton of the Tisza. —

Answer: The saprobic system is, unfortunately, not perfect. The quality of water is deteriorated by the pollution. According to his observation, the two-peaked maximum originating from the phenological rhythm of the zooplankton does not become blurred. 70 to 75 percent of the species of the Maros are common with those in the Tisza.

MARIÁN, M.: He asks what the cause is that the results of the hygienic and zooplankton investigation of the Tisza-reaches at Csongrád do not agree entirely with one another. —

Answer: The error must probably be looked for in the applied system of qualification.

Andó, M. (a completion): The Tisza is considerably affected by the Maros, in microclimatic relation, as well. —

Answer: The lecturer thanks for the completion.

JÓZSA, Z.: The investigation into the microplankton is very cumbersome. It is not easy to give an unambiguous qualification on the basis of the microplankton organisms. His question is: what is characteristic of the quantitative composition of the microplankton organisms of the Maros. —

Answer: The number of organisms is very low.

(13) BODROGKÖZY, GY. and † HORVÁTH, I.:

Effect of light conditions on the plant associations of marshy meadows

The white poplar groups formed in the marshy meadow of Körtvélyes island enables the investigation of the different daily rhythmical changes in the illumination intensity and of the effect of shading under field conditions. It is known from the investigations carried out in a phytotrone that illumination-intensity and its daily rhythmic change are important factors of the vegetable organic-matter production.

The nearly circular tree-groups have a diameter of 40 to 60 m. They are 15 to 20 m high and the marshy-meadow association round them may be regarded as identical.

Between June and September, 1978, we performed stand-climatic investigations round a tree-group like this. The stand structure exposed to different cardinal points, as well as the amount of the sub- and supersurface phytomasses were determined.

The marshy meadow round the tree group is *Lythro-(virgatae)-Alopecuretum pratensis,* which in 1978, owing to the floods in 1977–1978, changed into *Carici (melanostachyae)-Alopecuretum pratensis.*

In the stand-climate, as a function of being exposed to different cardinal points, the difference is of considerable degree. In north-south exposition, for instance, in a height of 10 cm over the ground, the difference of temperature can even reach 6–7 °C.

Exposed to west, the shade before noon increased the ratio of *Alopecurus pratensis* and excluded *Glycyrrhisa echinata.* In northern exposition, the effect of the contin-

uous shading is also similar. In southern exposition, the ratio of the two species has changed inversely.

In the morning, the amount of phytomass was increased by the higher intensity of illumination, as well as by the continuous shade effect. In northern exposition, this effect was 25 percent higher than in the southern one.

Contributions to the discussion:

KISS, I.: His question was, whether there are any data in the literature on the subject, concerning how the amount and composition of the amino acid, as well as the amount of other materials formed in the plant, are affected by the light effect at noon and in the afternoon, depending upon the composition. —
Answer: The investigation into the distribution of the light effect is methodologically difficult. It is therefore very difficult to elaborate the most suitable procedure.

ANDÓ, M.: The lecture has been an object-lesson of how important it is to calculate the production. His question is whether the temperature gradients between the given shaded areas can be explained and separated. —
Answer: It is planned to perform investigations into the internal content of the organic matters.

TÖLGYESI, GY.: He speaks with appreciation of the lecture and offers his co-operation. His question is whether the difference of the amount of CO_2 was examined, as compared with the plants in the dry land. —
Answer: The authors are indebted for a possible co-operation of GY. TÖLGYESY and count on it.

DÓSA, J.: He asks, how the amount of phytomass can be increased by the maximum exploitation of the light conditions. He expounds that the leaves of coniferous woods in lower regions use more water in less light than those being in the upper level but they produce only few assimilata.
Answer: At the beginning of illumination the light energy is high and the production (density of individuals, size, quality of the produced organic matter) is increased by this.

MARIÁN, M.: This lecture has a connection concerning the multiplication of invertebrata, as well. Owing to the increase in plant production the individual number of animals increases, too.

TÖLGYESI, GY.: The quantity of assimilata is strongly affected by shade and light. He repeats offering his willingness to co-operate.

GYŐRFFY, GY.: He asks whether the amount of organic matter produced in different phases of illumination was investigated. —
Answer: The climate-examinations of the stand are more detailed than it could be exposed shortly in the lecture. — On the basis of the general exposition, there is no difference either in temperatures or in vapour contents. This is understandable due to the small area.

(14) KOZMA, A. and TÖLGYESI, GY.:
Plant associations of the Middle-Tisza flood-plains and inundation areas and the agricultural utilization of these

Between the years 1975 and 1977 we carried out investigations in several flood-plains and inundation areas along the river Tisza, on the basis of considerations indicated by the title. The plant association that is dominant in the investigated areas is Salicetum albae-fragilis. Consequently, the most important economic factor predominating in the inundation areas of the Tisza is sylviculture. We can also draw a distinction zonally between the mesohygrophilous, semi-ruderal plant associations on the river banks, as well as between the levee and the soft-wood gallery forest. The plant associations on the river sides are also semi-ruderal. The underwood of the soft-wood gallery forest is composed of dry-stalked weeds and poisonous plants. This area is not good for grazing. The secondary flood-plains are partially covered with widespreading grass pastures and, in places, over a large area, the arable land is tilled.

The mineral content of the plants growing in the investigated flood-plain and inundation area was measured, repeatedly two times, relating to six macro- (K, Ca, Mg, P, S, Na) and seven microelements (Al, Fe, Mn, Zn, Cu, B, Mo). It was found

that the plants growing in the areas bordering the Tisza had accumulated a much larger amount of minerals in their tissues than the meadow hays and the vegetation of the flood-plains along the river Danube, where we had also conducted investigations. On the evidence of the soil analysis made by us, the soil in the inundated areas along the Tisza has everywhere a slightly acid reaction. Not more than 8 to 10 p.c. of the area can be turned into pasture or hay-field.

Contributions to the discussion:

BODROGKÖZY, GY.: The investigation fits very well into the material of the monograph begun by him at present. The mentioned *Bolboschoenetum* association may have been something else than the association designated by him. There can occur no *Artemisio-Festucetum* association in the flood plain. He asks to designate the site exactly. He has observed an increasing alkalization in the flood plain. He expresses his thanks for the good lecture.

DÓZSA, GY.: We must not speak of a *Rubus caesius* infection, says he, because this species has an importance here, for instance, from the point of view of sustaining the stock of game. — Answer: The expression "infection" in connection with Rubus caesius was only a slip of the tongue.

HORVÁTH, I.: He considers the investigations as conclusive.

ANDÓ, M.: The high iron and sulphuric content of the soil of the Kisköre Reservoir may later raise considerable problems as a result of the hydrogen sulphide formation. — Answer: Tse cause of the large amount of iron anii sulplur found in the Ktsköre Reservoir ts unknown. In the water of the Tisz5 dtssolved iron occurs but tn a very samall amouni.

ANDÓ, M.: The high iron and sulphuric content of the soil of the Kisköre Reservoir may later raise considerable problems as a result of the hydrogen sulphide formation. — Answer: The cause of the large amount of iron occurs but in a very samall amount.

KISS, I.: He regards as considerable that the areas along the Tisza, however deficient in lime they are, contain more of manganese. This ís an essential datum from the point of view of plant physiology.

(15) TÖLGYESI, GY.:

Some regularities of the intake of mineral matters by the different plant species in the Upper-Tisza flood-plains

I have analysed the flood-plain vegetation in the Upper-Tisza Region, between Tivadar and Tiszaszalka, in five habitats, concerning 13 macro- and microelements. In the course of elaborating the data, in connection with the different plant species living in the same habitat, the following could be established.

The standard deviation of the microelement content of the plant species collected from a smaller sector of the flood-plain, within a distance of 50 to 100 m, is larger than that of the macroelements. In this way, iron can be characterized with the variation coefficient of 82–84, zinc of 45–140, molybdenum of 69–150 percent value. The same value was in case of magnesium only 33–59, at phosphorus 19–38, and at potassium only 18–35 p.c.

In the composition of the different plant species of a habitat in respect of 13 elements 77 correlations may be taken into consideration. From among these, four element-pairs were significant in every habitat. The calcium and magnesium, calcium and boron, aluminium and iron contents of the plant species, living in the same habitat, as well as their readiness to intake are parallel.

From the result of the survey taxological and ecological conclusions can be drawn.

Contributions to the discussion:

KISS, I.: The lecture has enriched our botanical knowledge. The quantity of macroelements is phylogenetically determined. It is therefore that of monocotyledons the low, of dicotyledons the high cobalt quantity is characteristic.

HORVÁTH, I.: How much is the environment for the quantity of microelements determinative?
BODROGKÖZY, GY.: How much does the quantity of macro- and microelements depend upon the hydrographical conditions of the inundation area? The accumulation of iron takes place under anaerobic conditions. He regards as necessary to continue the investigations in order to learn why just in this place the given plant association developed. —
Answer: The inorganic matters are suitable for demonstrating the phylogenetic evolution, relationship of the living world.

OBRADOVIĆ' MELANIJA:

(Her lecture was published in the Tiscia, vol. 1979)

Contributions to the discussion:

KOZMA, A.: He is glad of the lecture because he deals with this subject, too.
HORVÁTH, I.: He took pleasure in the interesting floristic lecture.
BODROGKÖZY, GY.: This lecture is good also because it indicates the exact date of distribution, as well. *Echinocystis* and *Typha laxmanii* occur in this country already in large numbers. In the rice-fields the latter is a furrow-weed.
GALLÉ, L., Sr.: When he was a boy, he lived in the mentioned area. He knows it well. It was therefore interesting for him to hear about the changes having taken place since that time. —
Answer: Until 1960–1966, the floristic research was slower in the Voivodeship because there were no research workers for this purpose. Since then, the research work has accelerated. *Echinocystis lobata* is a furrow-weed in the Voivodeship, as well. *T. laxmanii* is already very frequent in Syrmia, too. It can be found even in the licks. The Tisza has no part in its distribution.

(17) KISS, I.:

Problems of the environmental and nature conservation of dead-arms and tributaries in the Upper-Tisza Region

The dead-arms of the Tisza have also a bearing on its living world. This can be said even more so of the tributaries which increase trophity, saprobity and toxicity more and more frequently. In the Summer of 1978, in the Upper-Tisza Region, we investigated four dead-arms and four tributaries from algological point of view. The water of the dead-arm at Tiszadob could be described as comparatively clean in which Chlorococcales frequently appeared. The foggy marshland at Tiszaluc and its small dammed western part, the so-called Takta-Reservoir, are already strongly eutrophicated.

From among the tributaries, the Sajó at Putnok was very strongly polluted. Its water was dark brown in a long stretch, plankton algae occurred in it only exceptionally. The water becomes more polluted at Putnok, as well. The Bodrog reaches Sárospatak already polluted and its pollution continues increasing. The Takta, increased with the Szerencs brook, is also polluted, and is poor in phytoplankton. The Eastern Main Channel is of slow flow on the confines of Tiszavasvár, its algal population is rather rich.

From the point of view of nature conservation the dead-arm at Rakamaz is to be mentioned. In the riverside zone of this, opposite to the community, the white water-lily *(Nymphaea alba* L.*)* grows in dense stands. Its occurrence in large numbers is a less-known sight of the community, it demands, therefore, an increased attention in the nature conservation work. The lake Fehérszik-tó on the eastern confines of Tiszavasvár is already a nature reserve, getting also Tisza water, its alkalinity has considerably decreased.

Contributions to the discussion:

BALÁZSFALVI, Mrs. A.: She thanks for the lecture and is glad that it called the attention to the mistakes made by the environmental and nature conservancy. She asks the lecturer and others, too, for help in order to perform their duties always better.
Answer: The lecturer offers his services to the Environmental and Nature Conservation Office.

MARIÁN, M.: He asks if in the course of his investigations he met any dead-arm in which a saligot (Trapa natans) stand of large extent could be observed. —
Answer: He has not found any well-developed thalli of saligot.
By what is the brown discolouration of the Sajó induced? — asks M. MARIÁN — Is it perhaps a pollution caused by a factory? He calls the attention of the Station of Public Hygiene and Epidemics to that much gargabe, oil is taken in the water by ships.

HEGEDŰS, M.: She asks if the lecturer found in her collecting sites the Sphaerotilus natans species, indicating a pollution caused by the sugar-works. —
Answer: She has not found the *Sphaerotilus natans* species.

GALLÉ, L., Sr.: Why is the stand of saligot forced back? Does the Nymphaea alba not annihilate itself as a result of the alluvial deposit? —
Answer: The Stratiotes stand is forced back as compared with the earlier states. — He has not found *Nymphaea alba* elsewhere in such a large stand.

B. TÓTH, M.: About ten years ago, the dead-arm at Végaldó was full of saligot. But after raising the water surface and setting up a duck-farm it became extinct.

JÓSA, Z.: The coloured pollution of waters is caused by the leather factories, e.g. in the Bodrog. The mesoplankton and the stock of fish become extinct. —
Answer: In the Bodrog many oil stains were found. It is not known exactly, where they originate from.

I. FODOR: The filtering of pollution should be solved by means of the vegetation.

(18) BÁBA, K.:
Stocking of the flood-plain with mollusc species and some lessons of succession

In my investigations I have looked for an answer to whether in the flood-plains, disturbed by water, the succession of gasteropoda is parallel with phytocoenoses, as well as what kinds of structural changes take place.

It can be demonstrated on the basis of TW values established for the snail species — like for plants — that the standard deviations of the TW average values of plants and snails refer in the course of succession mathematically significantly to ecological parallels. In the course of the primary succession, species of 8 to 10 W values settle down. These are in a low flood-plain: Succinea oblonga, *Perforatella rubiginosa;* on a higher site, at the border of the river bed, besides the former ones, the snails preferring W 5 (fresh) degree: *Cochlicopa lubrica, Vallonia pulchella* are frequent species. At a still higher level of the terrain, some species preferring fresh-half-dry humidity occur. The snail communities of the gallery forests disturbed by water may only periodically have originated from the willow-plantations, their constant-dominant species are less hygrophytic. The ground has rising tendency, lower and higher levels alternate. The snail communities are, therefore, mosaic-like.

In the clay, on a "cold soil", the frequent species are more hygrophytic on higher terrains, as well.

In the shrub-willow beds and willow poplars, there are only two species that show a higher affinity than 0.5. (With Kendall's method and with a significance examination suggested by I. PRÉCSÉNYI). These are highly hygrophilic, owing to the constant water-disturbance of the flood-plain. These two species are: *Succinea oblonga* and *Perforatella rubiginosa.*

Contributions to the discussion:

GALLÉ, L., Jr.: The lecturer has grasped the problem very well. On the basis of what did he choose the TW values? In his opinion, the principle of higher diversity, higher stability cannot be true.
KISS, I.: He takes with joy the tendency to reckon diversity on mathematical basis.
FARKAS, Á.: Do the snail species indicate the degree of pollution?
MARIÁN, M.: It is necessary to make clear some notions of plant association.
His questions are: Has the lecturer any experience in respect of how the snail species living in the flood-plain survive a long-lasting flood like that in 1979?
Lecturer's answers: He agrees with the opinion of GALLÉ, Jr.
The different species of snails and shall-fishes, as well, indicate the pollutions of different strength with decrease in their individual numbers.

(19) GALLÉ, L., JR.:

Niche analysis of ants (Hymenoptera: Formicoidea), with special regard to the grass associations along the Tisza

The author, in the course of his analysis carried out on 40, mainly lowland grasses, has investigated 30 grasslands along the Tisza, studying the following dimensions: macrohabitat, size, parasitism, microhabitat, and activity.

On the basis of their niche width, the investigated species can be classified into three (generalist, specialist, and "xen") groups in the dimension of the macrohabitat. In the macrohabitat dimension, primarily the compulsory physical conditions are responsible for the separation of niches. In the open field, the correlation measured in the relation of the compulsory physical condition and density does not reflect the real, fundamental niche centre in every case. The populations are mostly constrained to deviate from that in their realized niche and are in a sub-optimum situation under the pressure of their dominant competitor. The niche overlap of the macrohabitat dimension (H_T—H_B) is the least. By this, the correctness of Gause's hypothesis is proved on ants, Separation may be considerable in the microhabitat and activity dimensions, as well.

On the basis of the niche analysis, two competing basic strategies can be demonstrated at the ants of grasses: (1) interspecifically dominant species: their intraspecific aggressivity threshold is often low, owing to polygynia or the polycalic colony formation; (2) intraspecifically subordinated species of an intraspecific contest-competition which — under their conditions close to Gause's situation — can only avoid extinction by means of a niche separation which is disadvantageous to them.

Contribution to the discussion:

KISS, I.: He deems the evaluation carried out on mathematical basis as very good.
BÁBA, K.: What is expressed with "agressivity" in this case? —
Answer: If the diversity of coenosis increases and it is stabilized, the niches are more separated from one another and competition increases. The aggressivity between the different ant species was studied in a laboratory.
MARIÁN, M.: Can the animals live in different biotopes but belonging to the same species be in competition with one another? —
Answer: Competition can only come into question if the niches overlap one another but only if there is a poverty in food. If there is plenty of food, there is no competition.
BODROGKÖZY, GY.: Some species live on a given territory because they have no other choice but to live there. For him this has been very important in the lecture.

(20) TANÁCS, L.:

Regeneration of the Apoidea insect fauna in Körtvélyes island, taken as a function of the flood-waves

The investigations were carried out in Körtvélyes island in 1975, 1976, and 1977. The observed area was divided into zones. The dike slope surrounding the island had a part in fauna control.

In the inundation areas, the Apoidea insect regeneration is a function of the duration resp. dates of the flood waves. The vegetation regenerates one and half to two months after passing of the flood-waves. After summer floods, there cannot be formed any continuous plant associations any more. On the other hand, the result of late-spring floods is a continuous vegetation.

The structure of the Apoidea insect population is primarily determined by the nutritive plant connections.

In the investigated area, the factors determining the regeneration, resp. structure of the Apoidea population are: the climatic conditions, the poverty in the species combination of the vegetation, the effects of culture, the distance from the dikes.

Contributions to the discussion:

BÁBA, K.: Is there any correlation between the individual and species numbers of bees and the number of flowers? —
Ans wer: Yes, there is.
Is there induced any change in the species and individual numbers by the mowing of levees? —
Answer: Mowing takes place in sections. The bees should, therefore, not fly far away.

(21) FARKAS, Á.:

Multiplication and growing circumstances of the pike

The annual floods of the Tisza enable the fishes to get into the borrowing pits and dead-arms of the flood-plain. After the spawning following the spring flood, the young fish, having gathered strength in the course of Summer, can again get back into the living river from the dead-arms and borrows with the autumn flood.

I have established, in the course of investigating into the spawning, multiplication and alimentary conditions of the single fish species, that in the dead-arm at Körtvélyes the quantity of the stock of carp, silure and pike-perch annually considerably changed while the number of the caught pikes has shown a comparative stability. In the north-western section of the dead-arm, owing to the water vegetation and the low water (1 m), fishing could not be carried out with the method of large tools (fishing sweeps). In this area, therefore, there have always remained enough pikes for the further multiplication.

According to my experience, the pikes did not leave the dead-arm with the autumn flood, either. Their spawning takes undisturbedly place in the bordering waters of the dead-arm grown with water plants. On 20 February 1978, the fishers. caught fully spawned individuals and in 1979 spawning began only in mid-March.

In May, 1978, the length of the young pike was 35 to 45 mm. They grew till September to 160 mm and 100–150 g weight. The spawners that are not much older than one year, till May–June reach even 1000 g body weight.

The alimentary and growing conditions are, therefore, favourable for the multiplication of pikes.

Among the dissected specimens I have found *Abramis brama, Rutilus rutilus, Alburnus alburnus* individuals.

Contributions to the dissection:

CSIZMAZIA, Gy.: To his knowledge, "Razbora" appeared — sometimes in large numbers — in some waters of Hungary. He asks if it is known from the Tisza. —
Answer: The mentioned fish belongs to the ablets *(Alburnus alburnus)*. In fish-ponds it has already really occurred in large numbers but he has no information on its occurrence in the Tisza.

BALÁZSFALVI, Mrs. A.: She asks why the individual number of the pike is unchanged in the investigated dead-arms —
Answer: The pike, in contradistinction to the pike-perch, does not leave its biotope on the occasion of the Tisza floods — it is attached to the area with saligot.

BÁBA, K.: Is the appearance of Lota lota in the lower reaches of the Tisza frequent? —
Answer: It is rare in the mentioned reaches.

MARIÁN, M.: How was the age of fishes established? —
Answer: In this case, it took place on the basis of fish-scales.

(22) WOLLEMANN, MÁRIA:

Sonogram analysis of the sounds of the night heron *(Nycticorax* L.) in the heronry at Labodár

The sound of night herons in the heronry at Labodár was followed with sonogram analysis from the formation of pairs till the raising of nestlings, from early April till mid-July, 1978.

In the heronry 60 pair nested. Still in the time of carrying the matter to the nest, we observed a new, characteristic sound which we considered as calling the fellow bird. This was, as opposed to the characteristic "quak"-sound of the night heron, a melodious, sound repeated 3–5-times, emitted by solitary birds perching on a tree. The frequency of the sound culminated at the end of April. Later it was only emitted in the morning and evening hours and in the second half of June it entirely ceased to be heard.

I have first perceived the sounds of young birds in the middle of May. These became stronger from week to week. In mid-June, the young birds already left their nests and perched on the adjacent trees.

Contributions to the discussion:

SZITÓ, A.: Is there any difference between the sounds of the different sexes? —
Answer: She has no knowledge of that.

GALLÉ, L., Jr.: Did the individual number of the birds of the heronry changed lately? —
Answer: The stock became rarer, in fact, owing to the decrease in the forest areas.

(23) CSIZMAZIA, GY.:

Effect of the back areas on the mammalian fauna

The extension of the continuous ecological researches is made necessary by the environment of the Tisza changing by leaps as a result of the human activity. In some basic areas of the Tisza research, in the biotopes not only in the flood-plains but also on the protected side, the trappings of small mammalia and analyses of casts were continued. On the course of these, new ecological effects and connections were brought to light.

The large-scale change, which was a result of the river control, has induced an intensive quantitative decrease in the mammalian stock. In the past one and half decades — in connection with the effect of inundation — the horizontal and vertical distribution of mammalia in the single flood-plain biotopes was established.

On the basis of coenological characteristics some mammalogical units of independent ecological and dynamical structures developed in the flood-plain — in spite of its mosaic complex biotopes. Of late years, the changes that followed in the Tisza valley (river barrages, high and lasting flood waves, the intensive agriculture of the protected side) brought about a considerable quantitative and qualitative transformation, the impoverishment in the mammalian fauna in the investigated reaches. In connection with this it may be ascertained:

(1) The ecological change of anthropogenous root in the areas outside the dike prevails more and more intensively in the life of the mammalia in the flood-plain.
(2) In the investigated reaches where there is no "mirror" biotope (as it was destroyed), similar to that in the flood-plain, on the protected side: the quantitative and qualitative destruction of the mammalian fauna is 50 to 90 percent. (Period between 1963–1978).
(3) The quantitative decrease in the mammalian stock (Chiroptera, Carnivora, Insectivora) can also be registered in case of the mosaic-complex (mirror) biotopes on the protected side.
(4) The cast analysis cannot be used for the comparative coenological investigation- and description of the small-mammalian populations of the flood-plain biotopes and protected areas. The methods of parallel and quadratic trappings may be applied.
(5) In the inundation area of the Tisza, the purposes of nature conservation and game management could not be achieved if we don't pay attention to protecting and managing the protected areas from ecological point of view.
(6) After terminating the agricultural system of detached farms with its bush and tree vegetation in the Great Hungarian Plain, some problems of game management and epidemiology have appeared. *(Capreolus capreolus, Lepus europaeus, Vulpes vulpes).*
(7) It is advisable to extend the research work into mammalia in future still more, even over the biotopes on the protected side of the Tisza valley and on carrying out investigations into the energy flow.

Contributions to the discussion:

BALÁZSFALVI, Mrs. A.: The National Office of Environmental and Nature Conservancy is opposed to clearing an area of beasts of prey by means of egg poisoning.

GALLÉ, L., Jr.: The use of poisoned eggs is an ecological scandal.

BÁBA, K.: He is of similar opinion and remarks that a great many useful and protected animals were exterminated as a result of this practice, mainly if used in the time of brid migrations.

TANÁCS, L.: The growing of lucerne is decreased by the fosdrin treatment because the pollinating bees perish for fosdrin. How general is the use of this drug in the investigated area? — Answer: It is general in the form of poisoned eggs and it is also used by agrochemistry.

ERDEI, M.: The stock of games, mainly of hares, partridges and pheasants, decreases owing to the technique of lucerne-mowing, as well.

MARIÁN, M.: How was the size of the area of motion of the mentioned mammalia established? — Answer: The simplest way is to dig bottles with wide orifice in the ground and mark the mammalia getting into these.

(24) ERDEI, M.:

Game-sustainig capacity of some forest types in the Region Conservation District at Mártély
(No lecture-abstract received)

Contributions to the discussion:

FODOR, J.: In the Upper-Tisza Region a new adventitious plant became general, the "American sunflower", driving back the Sălicaceae. This is Helianthus rigidus. Has it already appeared in Hungary, too? —
Answer: It has not, as yet.

(26) STAMMER, ARANKA, HORVÁTH, I., and CSOKNYA, MÁRIA:
Chromatophores of fishes in the Tisza in connection with the change of environment

The morphological bases of the constand changing patches of colour of our fishes in the Tisza are ensured by the chromatophores of the skin. The ramifying processes of the cells of connective tissues transformed into choloured plastids are very different in the investigated species. The forms of extension are determinants not only for the major taxonomic categories but for species, as well.

It is a matter of curiosity that the chromophores immigrate from the corium between the epidermal cells, too. This is the most obvious in the skin of the pike and silure, in respect of the part of the body: in the visceral zone of the head and along the lateral line. The tiny granules of the plasmatic pigment are electron-microscopically electron dense granules of different length. At plasmatic contraction occurring under hormonic activity the size of pigments strongly changes, by the aggromelation of granuls a considerable difference in colour may take place.

Differences in colour of the matter of granules, resp. an occasional stratification of chromophores cannot be supposed in fishes. In the basal layer of the epidermis there are no pigments. In the waters polluted with paint the plasm of the epidermis cells becomes granular. This can be connected with the destruction of cell organella, mainly mitochondria, with an increase in the number of lysosomes and the induction of skin wounds. At the hormonal effects of the multiplication period no essential morphological change was found.

Contributions to the discussion:

MARIÁN, M.: The migration of chromatophores takes place as a result of hormonal effects. How fast is this? —
Answer: It is very fast. At frogs it can even be a few minutes.

(26) CSOKNYA, MÁRIA, HALASY KATALIN, and STAMMER, ARANKA:
Morphological studies on the intestinal canal of some water larvae Zygoptera

The authors have carried out their observations on the alimentary tract of the larvae of may-flies, Isoptera, as well as Anisoptera dragon-flies. The straight, tube-shaped intestinal canal of the larvae is divided on the basis of the histological structure into anterior, medial and posterior intestines. Besides discussing the histological structure of the single sectors of the intestinal canal, the authors also refer to the functions of these. Thus the anterior intestine carries out mainly the storage of food, the medial intestine the digestion and absorption, and the posterior intestine the removal of waste material and decomposition products. This is shown by the rectal papillae, the epithelial cells which participate in the ion and water transport and the intestinal branchiae even in the performance of the respiratory metabolism. The structure of the different cell types of the intestinal branchiae is also outlined.

Contributions to the discussion:

GALLÉ, L., Jr.: How much are the osmoregulative cells affected by the salt concentration of the environment? —
Answer: It is sure that the number of the osmoregulative cells is higher in a thinner solution.

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